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The Trident Warrior experimentation process

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THESIS

THE TRIDENT WARRIOR EXPERIMENTATION PROCESS

by

Kevin Barrett

June 2005

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13. ABSTRACT (maximum 200 words)

The Chief of Naval Operations defines FORCEnet as the "operational construction and architectural framework for Naval Warfare in the Information Age which integrates warriors, sensors, networks, command and control, platforms and weapons into a networked, distributed combat force, scalable across the spectrum of conflict from seabed to space and sea to land." The Trident Warrior experiments are the Navy's premier FORCEnet Sea Trial experiments. The purpose of the Trident Warrior experiments is to provide "speed to capability" and to develop supporting tactics, techniques, and procedures

The purpose of this thesis will be to provide a basic overview of the Trident Warrior Experimentation Process. Through a step-by-step analysis, this thesis will explain and justify the many steps required to complete a successful experiment/experimentation campaign.

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THE TRIDENT WARRIOR EXPERIMENTATION PROCESS

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Submitted in partial fulfillment of the
requirements for the degree of

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The Chief of Naval Operations defines FORCEnet as the "operational construction and architectural framework for Naval Warfare in the Information Age which integrates warriors, sensors, networks, command and control, platforms and weapons into a networked, distributed combat force, scalable across the spectrum of conflict from seabed to space and sea to land." The Trident Warrior experiments are the Navy's premier FORCEnet Sea Trial experiments. The purpose of the Trident Warrior experiments is to provide speed to capability and to develop supporting tactics, techniques, and procedures. Speed to capability provides a rapid fielding of improved capabilities to the fleet. The supporting tactics, techniques and procedures optimize the employment of the new technology.

The purpose of this thesis will be to provide a basic overview of the Trident Warrior Experimentation Process. Through a step-by-step analysis, this thesis will explain and justify the individual steps that comprise a successful experiment/experimentation campaign.

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I. INTRODUCTION

A. SEA POWER 21

In October 2002, Admiral Vernon Clark, the Navy's twenty-seventh Chief of Naval Operations (CNO), laid out his vision for the Navy of the future in Sea Power 21. Adm. Clark foresees, "Future naval operations [that] will use revolutionary information superiority and dispersed, networked force capabilities to deliver unprecedented offensive power, defensive assurance, and operational independence to Joint Force Commanders" (Sea Power 21). The three pillars of Sea Power 21 are Sea Strike, Sea Shield, and Sea Basing.

Figure 1. Sea Power 21(From: Sea Power 21)

Sea Strike is the ability to inflict a persistent and precise offensive force. In order to provide this offensive power, Sea Strike must be capable of persistent

intelligence, surveillance, and reconnaissance; time sensitive strikes; electronic warfare and information operations; ship-to-objective maneuver; and covert strike. Sea Strike will provide an amplified, effects-based striking power; increase effectiveness of precision attacks, enhance the war fighting contribution of Marines and Special Forces, and allow seamless integration of joint strike packages. The capabilities associated with Sea Strike will continue to grow with technological advances in unmanned combat vehicles, hypersonic missiles, electro-magnetic rail guns, and a vast array of sensor improvements.

Sea Shield provides defensive assurance to our forces and our allies across the globe. Sea Shield will provide layered, global defensive power based on control of the seas, a forward presence, and networked intelligence, in order to enhance homeland defense, assure littoral access, and project power inland. Future technologies within Sea Shield include integrating existing technology into a common undersea picture and a single integrated air picture, intelligence and communications reach-back systems, theater missile defense, organic mine countermeasures, and autonomous unmanned vehicles. Ideally these technologies will expand combat reach, create a common operating picture, and improve self-defense capabilities to ensure sea superiority.

Sea Basing provides operational independence to naval forces, as well as support for the joint force. Sea Basing will provide pre-positioned war fighting capabilities, enhance joint support for a dispersed naval force, increase force security and operational agility, and minimize

reliance on shore infrastructure. Sea Basing must provide positioning afloat, offensive and defensive power projection, logistical and command and control (C2) support, and accelerated deployment and employment timelines for joint assets. In order to meet these challenges, Sea Basing will need increased capabilities to move heavier cargo faster, the ability to access all cargo while at sea, and enhanced and integrated Joint C2 and logistics capabilities.

Sea Power 21 implements a Global Concept of Operations (GCO) that disperses combat power through a variety of platforms that possess an immense warfighting capability. This will allow us to "dissuade, deter, and defeat both regional adversaries and trans-national threats" (Sea Power 21).

While Sea Strike, Sea Shield and Sea Basing are the three pillars of Sea Power 21, a triad of organizational processes, Sea Warrior, Sea Enterprise, and Sea Trial, will be used to align and accelerate the development and incorporation of new technology for the fleet. Sea Warrior will invest in the Navy's human capital. Today's Navy employs cutting edge technology, requiring naval personnel to be both highly skilled and highly trained. Sea Warrior will provide Sailors who are skilled, motivated, and properly employed, producing a more effective, more efficient fleet. Sea Enterprise will incorporate modern business practices to reduce costs and improve efficiency. Sea Enterprise seeks to further improve efficiency by seeking opportunities to work with other services on common goals. Joint operations save money, improve inter-operability, and promote system integration.

The final process designed to implement Sea Power 21 more smoothly and effectively is Sea Trial. Sea Trial is a fleet-led process of concept and technology development that delivers enhanced capabilities to the fleet. Sea Trial will coordinate the fleets, technology development centers, and academic resources to integrate wargaming, experimentation, and exercises that will increase warfighting capabilities.

> We often cite asymmetric challenges when referring to enemy threats, virtually assuming such advantages belong only to our adversaries. "Sea Power 21" is built on a foundation of American asymmetric strengths that are powerful and uniquely ours. Among others, these include the expanding power of computing, systems integration, a thriving industrial base, and the extraordinary capabilities of our people, whose innovative nature and desire to excel give us our greatest competitive advantage. (Sea Power 21)

B. FORCENET

FORCEnet is the method in which the U.S. Navy will build on its asymmetrical strengths. FORCEnet is designed to be “the operational construct and architectural framework for naval warfare in the information age, integrating warriors, sensors, command and control, platforms, and weapons into a networked, distributed combat force” (FORCEnet: A Functional Concept). FORCEnet is often described as the ‘glue’ that holds Sea Power 21 together. FORCEnet will improve the speed and accuracy of the decision-making process, while integrating knowledge and providing a common operating picture to dominate the battlespace. This will ultimately allow commanders to make timelier, better-informed, and more accurate decisions. By increasing accessibility to information, FORCEnet will

create a network effect, exponentially increasing the value of information or capabilities provided by the network. FORCEnet will provide multi-tiered weapons grids; survivable networks; automated decision aids; and distributed, collaborative C2, while maintaining human-centric integration. FORCEnet will continue to promote a highly adaptive and decentralized form of command and control, empowering unit commander's initiative, adaptability and increased tempo, while maintaining the coordination of unity of effort that is provided by centralization.

> We have been talking about network-centric warfare for a decade, and FORCEnet will be the Navy's plan to make it an operational reality. Supported by FORCEnet, Sea Strike, Sea Shield, and Sea Basing capabilities will be deployed by way of a Global Concept of Operations that widely distributes the firepower of the fleet, strengthens deterrence, improves crisis response, and positions us to win decisively in war. (Sea Power 21)

C. TRIDENT WARRIOR

Trident Warrior (TW) is the FORCEnet component to Sea Trial. It is an annual event that focuses on pairing concepts and technology to provide enhanced capabilities to the fleet as rapidly as possible. The Naval Network Warfare Command (NETWARCOM) is the Sea Trial Operational Agent for FORCEnet, and is responsible for prioritization, coordination, validation, and oversight of all events within Trident Warrior (TW). NETWARCOM is the operational agent (OA), and the Space and Naval Warfare Systems Command (SPAWAR), is the chief engineer for the Trident Warrior experiments. The experiments seek to improve FORCEnet

Command and Control capabilities by providing the warfighter with information superiority over an adversary, which would allow the warfighter to make decisions and execute commands more efficiently. By providing these capabilities, along with full supportability and maintainability, Trident Warrior underwrites success in the battlespace.

Trident Warrior seeks to provide or improve upon many of the aforementioned capabilities of FORCEnet, including: multi-tiered sensor and weapon information; distributed, collaborative command and control; dynamic, multi-path and survivable networks; automated decision aids; and human-centric integration. Trident Warrior evaluates new technologies and approaches to resolving fleet needs using fleet experimentation and exercises. This is done in a spiral development process that enables the delivery of the new capability to be synchronized with the delivery of the required policies; tactics, techniques, and procedures (TTP); and concept of operations (CONOPS). Trident Warrior measures the benefits of proposed technology and demonstrates its real capabilities.

The end state of a Trident Warrior experiment is a Military Utility Assessment (MUA) that will provide a recommendation for advancements or changes in Doctrine, Organization, Training, Materiel, Leadership, Personnel, and Facilities (DOTMLPF).

D. FORCENET INNOVATION AND RESEARCH ENGINE

In order to facilitate the rapid dissemination of data, the Trident Warrior team utilizes the FORCEnet Innovation and Research Engine (FIRE website).

> "FIRE was developed out of the need for structured data collection, data reconstruction for analysis and generation of TW analysis reports. No such system previously existed, and the Naval Postgraduate School (NPS) the analysis lead for TW, was asked to examine different approaches. NPS developed FIRE as an enterprise computing solution, based on Oracle 9i and Oracle 10g technology, with unique artificial intelligence (AI) applications included in the design." (Poeltler and Gallup, 30)

FIRE has become a very useful tool for the Trident Warrior team. Access to FIRE allows the team to share both proprietary and confidential information, monitor the status of major objectives, and consult major reference publications that are written in conjunction with the Trident Warrior experiments.

E. TRIDENT WARRIOR EXPERIMENTATION PROCESS

Every Trident Warrior experiment begins with an overarching concept. This overarching concept is the general theme of the experiment. Recent themes of Trident Warrior Experiments include the Global War on Terrorism (GWOT) and the Command and Control (C2) of an Expeditionary Strike Group (ESG). Several key initiatives that will make significant contributions to the warfighter within this overarching concept are then identified. Each initiative is then dissected into multiple objectives that are essential to initiative development. Goals that are needed to realize the objectives are identified. The experimentation team then describes attributes that the proposed FORCEnet solution will need to meet each goal. Finally, the experiment is executed to compile data that will validate the attributes.

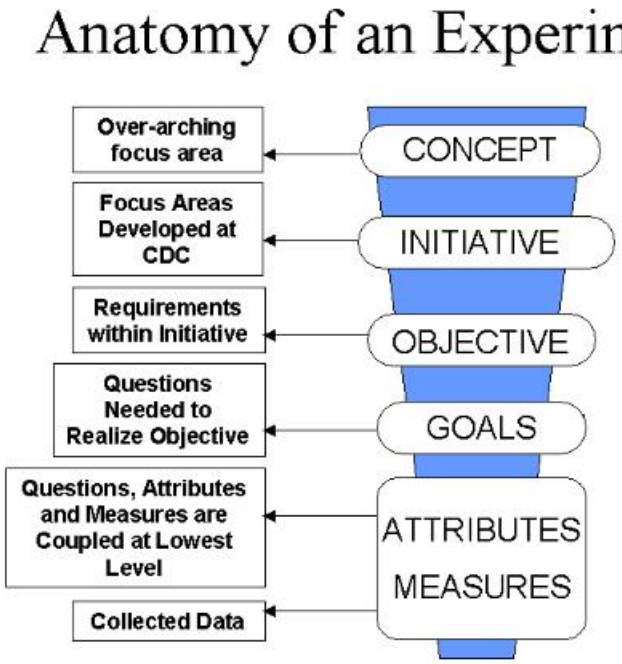

Figure 2. Breakdown of an Experiment

In order to promote successful experimentation, Trident Warrior has established the Trident Warrior Experimentation Process. By following the steps of this process in order and within the prescribed timeframe, the Trident Warrior team has maximized the potential for success within and experimentation campaign. The steps of the Trident Warrior Experimentation Process are:

1. Establish Team
2. Concept Development
3. Technology/Tactics, Techniques, and Procedures (TTP) Harvest
4. Asset Identification
5. Develop Experiment Objectives
6. Integrated Definition (IDEF)/ Operational Sequence Diagrams (OSD) /Process Action Maps
7. Experiment Design
8. Event Definition
9. Data Collection Plan

10. Execution
11. Final Report
12. Assessment Operational Agent Assessment (OAA)
13. Military Utility Assessment (MUA).

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II. ESTABLISHING A TEAM

Phase	1	2	3	4	5	6
Due Dates	Pre-CDC	CDC	Pre - IPC	Pre - IPC	Pre - MPC	Pre - MPC
Step	Establish Team	Concept Development	Technolegy / TTP Harvest	Asset Identification	Develop Experiment Objectives	IDEF / OSD / Process Action Maps
Required Product	Defined Names and R /R	Defines Experiment Scope and Focus Areas. Insure aligns with Naval Vision	Defines and Researches selected Tech and TTPs	Platforms IDed and Install Scheduled	Defines the So What and how to measure	Turns the Words into Design Diagrams

Phase	7	8	9	10	11	12	13
Due Dates	Pre - MPC	Pre-FPC	Pre - FPC	TBD	TBD	TBD	TBD
Step	Experiment Design	Event Definition	Data Collection Plan	Execution	Final Report	Assessment OAA	MUA
Required Product	Lays out the Flow and Appicable Scenarios to Meet Objectives	Defines the Detailed execution Plan	Maps the Data to be Collected to the means	Insure Plan is Flexable to changing enviornment	Must be Quick and Good	Necks down Analysis to Assessment	Necks Down Assessment to DOTMLPF Recommendations

Figure 3. Establish Team

An experimentation campaign is a major undertaking that will require various skills and expertise. Many individuals will be required to perform the numerous tasks required for success. Every individual will bring with them their own skill sets, personality traits, and ideas on how they believe the experiment should be run. Balancing the needs and desires of each individual, while ensuring that the group reaches its objective, can be a daunting task. In order to conduct a successful experiment, these individuals must refocus and realign their priorities to become a team.

A. WHAT IS A TEAM?

"A team is a small number of people with complimentary skills who are committed to a common purpose, performance goals and an approach for which they hold themselves mutually accountable" (Katzenbach and Smith, 1994).

1. Small Numbers

According to a study conducted by Katzenbach and Smith in 1994, most productive teams consist of a small number of people, usually between 2 and 25 people. The most highly effective teams usually consisted of less than 10 people. Teams comprised of a larger number of people experience difficulty in interacting constructively as a group. Large teams also have even more problems trying to agree on specific steps that should be taken.

2. Complimentary Skills

The fundamental tenant of teamwork is that the combined efforts will be greater than the sum of the individuals working alone. In order to maximize the team efforts, it is necessary that teams be comprised of members with varying skills sets. In general, there are three types of basic skills sets: technical skills, problem solving/decision-making skills, and interpersonal skills. A technical skill is a functional expertise within a specific area, such as marketing or engineering. A problem solving/decision-making skill can be used to identify problems and opportunities, evaluate options, and make the necessary trade-offs. There are a variety of interpersonal skills, including "risk taking, helpful criticism, objectivity, active listening, giving the benefit of the doubt, support, and recognizing the interests and achievement of others" (Katzenbach and Smith, 1994). It is important to note that both problem solving/decision-making

skills and interpersonal skills can be developed and enhanced throughout the life of the team.

3. Common Purpose and Performance Goals

True teams can be identified by their strong desire to achieve some greater common purpose. A common, meaningful purpose will set the tone and direction for the team. The team's common purpose should broadly frame the requirements and define the boundaries and scope clearly enough to keep the team on track. However, it must also be flexible enough to allow the team to evolve. This broad directive can then be narrowed into specific performance goals. By creating specific performance goals, the team will be able to track their progress: either the task is complete or incomplete; the objective was met or not met.

4. Common Approach

By uniting in a common approach, all team members stay on track and their combined efforts are maximized. A team's common approach should identify what each team member's job will be, how schedules will be set and adhered to, how the team will agree upon and modify decisions, and how to determine the best approach for getting the job done. In addition to these steps, most teams have members who will evolve into the roles of: "challenging, interpreting, supporting, integrating, remembering, and summarizing. These roles will help promote mutual trust and constructive criticism," (Katzenbach and Smith, 1994) within the team.

5. Mutual Accountability

In order to be truly effective, a team must hold itself accountable. Forced accountability from a supervisor usually works best with individual efforts, but self-accountability within a team will promote commitment

and trust. Each team member must keep in mind that if one person fails, the team fails.

B. TYPES OF TEAMS

1. Purpose Classification

One way to classify teams is by their purpose within an organization. Three common teams within this area include:

a. Problem Solving Teams

Problem solving teams are usually comprised of several individuals from different departments of an organization. This type of team meets regularly as an off-line discussion group that seeks to improve quality, efficiency, and/or work environment. They have no power to reorganize work or change the roles of workers in the production process. Suggestions resulting from problem solving teams have been found to reduce costs and improve product quality, but due to their lack of authority, have had little effect on how work is organized or managerial behavior.

b. Special-Purpose Teams

Special-purpose teams are formed to complete a specific duty, such as designing and introducing work reforms, meeting with suppliers and customers, and linking separate functions. Special purpose teams work on decisions at higher levels, creating an atmosphere for quality and productivity improvements.

c. Self-Managing Teams

Self-managing teams are smaller teams that produce an entire product or provide an entire service. Team members master multiple tasks and may even rotate between jobs within the team. These teams take over all

managerial duties, including scheduling, ordering supplies, and hiring. Self-managing teams fundamentally change the way work is organized, giving employees more control, eliminating the need for multiple management tiers, and removing bureaucratic barriers.

2. Task Oriented Classification

Teams can also be classified by evaluating the tasks they are organized to accomplish. These three categories are teams that recommend things, teams that make or do things, and teams that run things (Katzenbach and Smith, 1994).

a. Teams that Recommend Things

These teams include task forces, project groups, and audit, quality, or safety groups that are asked to study and solve particular problems. They usually have a set completion date and would benefit greatly from a fast and productive start. Teams that recommend things should also go to great lengths to gain commitment from the people who will implement their recommendations.

b. Teams that Make or Do Things

Teams that make or do things are performance driven and should focus on critical delivery points. Critical delivery points are the places in the organization that most directly influence the cost and value of the product.

c. Teams that Run Things

Teams that run things are extremely rare. Often groups of executives are referred to as a team, but they do not meet the fundamental definition of a team. Often, because of destructive conflict and a lack of trust, teams at the top are difficult to create. Although not as efficient as a team, a working group is more easily

assembled at this level. A working group presents fewer risks and allows its members to maintain an individual focus.

C. TEAM LEADERS

A good team leader has the ability to shape a team's vision and provide necessary guidance and oversight. A bad team leader can disintegrate a team into a group of unfocused individuals that can actually decrease productiveness from the start. When forming a team there are five critical steps involved (Katzenbach and Smith, 1994):

1. Establish urgency and direction
3. Set clear rules of behavior,
4. Set and seize upon performance oriented tasks and goals,
5. Challenge the group regularly with fresh information, and
6. Spend lots of time together.

Establishing urgency and direction will set the team down the correct path and will prevent wasting time trying to get the team on track. It is important to pay attention to the first meeting and actions, as this will set initial impressions. If team members see a hard working, focused leader, it is likely that they will be more focused themselves. Clear rules of behavior should be set regarding attendance, discussions, confidentiality, and expected contributions. Establishing a few performance-oriented goals will give the team confidence and motivation to begin moving forward quickly. Significant challenges will unify the team, and when accomplished will provide the team with determination and enthusiasm. Finally, spending

time together, both scheduled and unscheduled, will help build trust and reliability between team members.

A good team leader will put team performance first and recognize that they need the team's help to accomplish the goals. A team leader must delicately balance between providing too much command or too little guidance, as both can stifle a team's motivation. A team leader should follow these five elements for good team leadership (Katzenbach and Smith, 1993):

- Keep purpose, goals, and approach relevant and meaningful
- Build commitment and confidence
- Manage relationships with outsiders and remove obstacles
- Create opportunities for team members
- Do real work.

Additionally, a team leader should avoid:

- Blaming people or allowing individuals to fail
- Excusing away shortfalls in team performance.

D. CONCLUSION

"The single most important consideration for those responsible for experimentation design is to ensure that current expertise is available to support the plan" (Code Of Best Practices-Experimentation).

The potential of a team greatly exceeds the potential of the individuals within that team. In an experiment, this potential must be realized for success. The Trident Warrior '05 team provides an excellent blueprint for modeling other experimentation teams. Every individual has a particular area of responsibility. In this manner, the

team is able to hold itself accountable, and accomplish its goal.

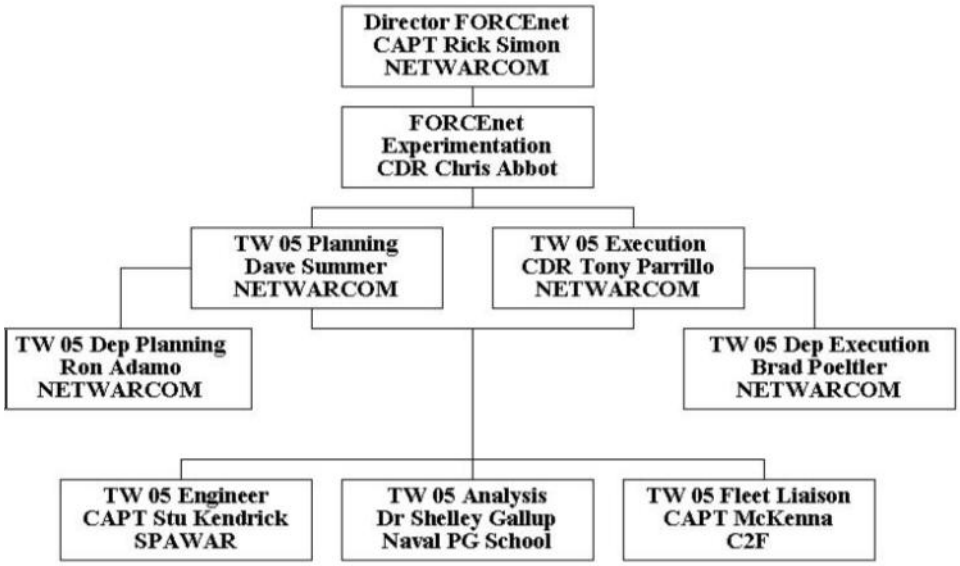

Figure 4. The TW ’05 Experimentation Team

III. CONCEPT DEVELOPMENT

Phase	1	2	3	4	5	6
Due Dates	Pre-CDC	CDC	Pre - IPC	Pre - IPC	Pre - MPC	Pre - MPC
Step	Establish Team	Concept Development	Technolegy / TTP Harvest	Asset Identification	Develop Experiment Objectives	IDEF / OSD / Process Action Maps
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Phase	7	8	9	10	11	12	13
Due Dates	Pre - MPC	Pre-FPC	Pre - FPC	TBD	TBD	TBD	TBD
Step	Experiment Design	Event Definition	Data Collection Plan	Execution	Final Report	Assessment OAA	MUA
Required Product	Lays out the Flow and Appicable Scenarios to Meet Objectives	Defines the Detailed execution Plan	Maps the Data to be Collected to the means	Insure Plan is Flexable to changing enviornment	Must be Quick and Good	Necks down Analysis to Assessment	Necks Down Assessment to DOTMLPF Recommendations

Figure 5. Concept Development

A. CONCEPT DEVELOPMENT CONFERENCE (CDC)

The primary event of the concept development phase is the Concept Development Conference (CDC). The purpose of the CDC is to define the experiment's theme, goals, and focus areas. The CDC is an attempt to get the primary stakeholders to agree on the overarching concept, or theme, for the experiment. Examples of overarching themes include the Global War on Terrorism, Expeditionary Strike Group Command and Control, and Bandwidth Management.

B. INPUTS FOR THE CONCEPT DEVELOPMENT CONFERENCE

Once the team has agreed upon an overarching concept, the major stakeholders in the experiment are each given a

turn to present possible initiatives for the experiment. They also relay relevant ideas, along with thoughts on how to improve the experiment. Within the Trident Warrior experiments, each stakeholder is given an opportunity to briefly define their proposed initiative and link their ideas to Sea Power 21, FORCEnet, or other applicable military doctrine. By the end of the CDC, everyone should have a common understanding of the overarching focus area, and the experimentation team can begin to determine which initiatives they will investigate.

When presenting a proposed initiative, the major stakeholders should concentrate on these key issues.

1. Capability Gap

The fundamental purpose of military experimentation should be to provide solutions that support the actual warfighter. These solutions may focus on changes to current Doctrine, Organization, Technology, Materiel, Leadership, Personnel, and/or Facilities (DOTMLPF). In order to be considered for military experimentation, initiatives should attempt to fill a void, or "gap" in current abilities that would allow our forces to achieve some desired future or current capabilities. As stated in the CDC for TW '06, "We are not doing experimentation for experimentation's sake; [our experiments] must fill gaps."

2. Current Efforts/General Info

Military experimentation should not attempt to recreate knowledge that has already been discovered. Initiatives should be researched, and the experimentation team should be informed of previous efforts and current developments within each field. A general overview of

previous/ongoing efforts related to these proposed focus areas should be outlined.

3. Experiment Relevance

In order to keep the experiment to a manageable volume, the CDC will attempt to determine if an initiative aligns with the current theme of the experiment. Again, teams should have some purpose behind their experiments, and not run experiments for the sake of experimentation. In military experimentation, this purpose is to fill gaps in warfighting capabilities. Allowing too many unrelated initiatives will result in the experiment wandering away from its overarching concept and becoming too large and unmanageable. This wandering is referred to as scope creep. According to NETWARCOM's Ron Adamo of FORCEnet Experimentation-Future Plans,

> Scope creep is an experiment's most dangerous threat. A solid CDC will help by firmly focusing the experimentation team (and stakeholders) on the key objectives. These objectives can change during the rest of the process but only with everyone's buy-in. Then possible deviations from the original plan can be addressed with a full understanding of how they affect the overall plan and available resources.

C. CONCLUSION

Once the team has agreed on a major focus area and relevant initiatives, they should review their roles and responsibilities within the new initiatives. This will ensure that team members understand the part they will play through the rest of the experiment.

The output of the CDC should be a concentrated list of initiatives that enables each of the experiment leads to begin concentrating their efforts. If everyone is

comfortable with this level of focus and direction at the end of the CDC then the experiment design team should be able to get to work in developing the detailed experimental objectives, questions and metrics.

IV. TECHNOLOGY/TTP HARVEST

Phase	1	2	3	4	5	6
Due Dates	Pre-CDC	CDC	Pre - IPC	Pre - IPC	Pre - MPC	Pre - MPC
Step	Establish Team	Concept Developmen	Technolegy / TTP Harvest	Asset Identification	Develop Experiment Objectives	IDEF / OSD / Process Action Maps
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Figure 6. Technology/TTP Harvest

A. BROAD AGENCY ANNOUNCEMENT

In order to attract innovative ideas both from industry and from other areas of the military, it may be necessary to issue a Broad Agency Announcement (BAA). A BAA is a notice from the government that requests scientific or research proposals from private firms concerning certain areas of interest to the government. The submitted proposals may lead to future contracts. According to the Federal Acquisition Requirement-Part 35:

> BAA's may be used by agencies to fulfill their requirements for scientific study and experimentation directed toward advancing the state-of-the-art or increasing knowledge or

> understanding rather than focusing on a specific system or hardware solution. The BAA technique shall only be used when meaningful proposals with varying technical/scientific approaches can be reasonably anticipated.

If not using a BAA, some other method of attracting outside technologies should be employed. These methods should describe the experiment's broadly defined areas of interest, the criteria for selecting the proposals, specify the period of time during which proposals will be accepted, and contain instructions for the preparation and submission of proposals.

BAA's imply program funding is available for an eventual buy decision. NETWARCOM does not control such funding, so TW does not typically issue a BAA. SPAWAR provides technologies in support of FORCEnet, to include TW experimentation. Additionally, word of mouth among industry, academia, and other military agencies attracts sufficient interest from outside sources.

B. ENTERPRISE DATABASE FOR INNOVATIVE SOLUTIONS OBSERVATION NETWORK

In order to gather beneficial technology/tactics, techniques and procedures (TTP) more efficiently, the TW experimentation team developed the Enterprise Database for Innovative Solutions Observation Network (EDISON), a web-based portal through which they can collect and review contractor-submitted proposals. EDISON provides a single point of entry for all information technology (IT), information management (IM), and human systems integration (HIS) solutions in support of FORCEnet. Additionally, EDISON provides a powerful data-mining portal capable of

extracting essential information from existing databases to provide the experimentation team with a wide awareness of programs and innovative solutions. This single entry point for submission of FORCEnet innovative solutions from industry, academia, the Department of Defense (DoD), and the Navy/Marine Corps team helps to eliminate the costly development of redundant capabilities and screen out solutions that are not in accordance with the enterprise architectural vision. EDISON provides tracking of these innovative solutions from discovery to acquisition, enabling the selection of optimal ideas from all sources. EDISON required that the data only be entered a single time and maintains the security of proprietary information (EDISON website within FIRE).

C. TECHNOLOGY DEVELOPMENT CONFERENCE

After all proposals are collected through EDISON, the Technology Development Conference (TDC) is convened to determine which proposals will be accepted and incorporated into the experiment. The TDC board should be comprised of decision makers from the command that is sponsoring the experiment (NETWARCOM for TW), as well as representatives from the Fleet Sponsor. The first act of the TDC board is to throw out all proposals that are not relevant to the current experiment, or are not in line with current Navy doctrine, organizational structures, or the current political environment. The Trident Warrior experiments do not seek to evaluate proposals for changes in established doctrine at the TDC. These proposals must be routed through the Naval Warfare Development Command (NWDC).

Proposed doctrine changes can then be forwarded to NETWARCOM for experimentation.

The TDC board should also remove any proposals that are not technically feasible or will not fit into the agreed upon timeline for the experiment. The Trident Warrior experiments have found it useful to divide the rest of the TDC into 2 phases. During the first phase, interested government entities are permitted an opportunity to give a brief presentation on technologies they wish to include in the experiment. Other government entities may want to include their technology for the purpose of testing or demonstrating capabilities. During the second phase contractors are permitted to give a brief presentation on technology they feel would be beneficial to include in the experimentation campaign. During this phase, the only parties present are the TDC board and the contractors giving the presentation. This separation is intended to protect contractor's proprietary information.

In order to be approved by the Technology Development Conference, a proposal must: (1) be a FORCEnet innovative solution adding value to the warfighter by enhancing current capabilities without detracting from current readiness or capabilities; (2) be aligned within the defined high level FORCEnet capabilities requirements, and concepts; (3) be consistent with, and build up, fleet priorities; and (4) provide feedback to the requirements/acquisition process for Navy wide delivery of FORCEnet capability. Additionally, within Trident Warrior, The objective is usually to leave the technology onboard the ships provided by the fleet sponsor, so the proposal should attempt to deliver end-to-end, supportable and

deployable leave behind capabilities. The amount of funding required from the experiment's sponsoring command (NETWARCOM for TW) would factor into the decision as well. (EDISON website within FIRE).

D. CONCLUSION

Technology and accepted tactics, techniques and procedures (TTP) should be gathered in an effort to optimize the experimentation effort. The level that these gathered technologies play within the experiment is dependent on the experiment's overarching focus area and the initiatives of the experiment. Regardless, the gathering of technology and TTP is a crucial step in the experimentation process. This step will ensure that the experimentation team fully understands the technologies, systems, tactics, techniques and procedures (TTP) they are about to test, and that the team can present new and innovative methods of employing these technologies and systems.

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V. ASSET IDENTIFICATION AND EXPERIMENT OBJECTIVES

Phase	1	2	3	4	5	6
Due Dates	Pre-CDC	CDC	Pre - IPC	Pre - IPC	Pre - MPC	Pre - MPC
Step	Establish Team	Concept Development	Technolegy / TTP Harvest	Asset Identification	Develop Experiment Objectives	IDEF / OSD / Process Action Maps
Required Product	Defined Names and R /R	Defines Experiment Scope and Focus Areas. Insure aligns with Naval Vision	Defines and Researches selected Tech and TTPs	Platforms IDed and Install Scheduled	Defines the So What and how to measure	Turns the Words into Design Diagrams

Phase	7	8	9	10	11	12	13
Due Dates	Pre - MPC	Pre-FPC	Pre - FPC	TBD	TBD	TBD	TBD
Step	Experiment Design	Event Definition	Data Collection Plan	Execution	Final Report	Assessment OAA	MUA
Required Product	Lays out the Flow and Appicable Scenarios to Meet Objectives	Defines the Detailed execution Plan	Maps the Data to be Collected to the means	Insure Plan is Flexable to changing enviornment	Must be Quick and Good	Necks down Analysis to Assessment	Necks Down Assessment to DOTMLPF Recommendations

Figure 7. Asset Identification and Experiment Objectives

A. ASSET IDENTIFICATION

It is very important to get the entire team to accept the experimentation campaign from the very beginning. An established commitment from every team member will promote trust and confidence within the team. Military experimentation has an added challenge, in that the platforms and some of the assets required to perform the experiment do not belong to the experimentation team. Military equipment and platforms are produced to support and defend the Constitution of the United States in the most effective manner possible. Sometimes this is means fighting wars, and sometimes this means enhancing

warfighter capabilities through experimentation. Due to the volatility of world affairs, it is often difficult to get a solid commitment from the military assets needed to perform the experiments. To make the situation worse, military experimentation often requires that experimental systems be installed on military platforms, requiring an even greater commitment.

1. Require a Commitment

A firm commitment must be obtained from the commanders of all required military assets. Without the confidence that all committed assets will be available at the time of experimentation, planners cannot begin to develop the experiment's objectives. Installation of experimental systems should be scheduled for the committed systems and platforms. Scheduled installation could take as long as two calendar years to complete. The commitment required from these commanders is very burdensome, but also very necessary.

2. Get Buy-In

The experimentation team should remember who has the ultimate authority over the assets. The most important support to acquire is the individual with the most influence over the assets. If you have the support of the boss, the staff will follow. In order to obtain this support, the experimentation team should be prepared to defend their efforts and detail the purpose of their campaign.

3. Be Flexible

When circumstances begin to change, it is important that the experimentation team remain flexible. World events frequently dictate the redeployment of assets. Platforms and systems that were reserved to carry out the

experiment may no longer be available. New resources may be available in their place, or a reduced quantity may have to suffice. It is important to maintain a flexible timeline and an adaptable experimentation plan in order to overcome these last minute changes. An experiment that improves knowledge is valuable, even if the knowledge gained is less than expected.

B. DEVELOP EXPERIMENT OBJECTIVES

Within this stage of the Trident Warrior process, the experimentation team attempts to refine the major initiatives agreed upon in the Concept Development Conference. At the CDC, the team agrees upon an overarching theme for the experiment, as well as some high level initiatives or focus areas. The team then splits these focus areas into specific objectives to accomplish, and formulates questions within each objective. Objectives relate to a specific capability that is to be explored through experimentation.

Developing objectives is fundamentally a social process of forming a shared understanding in order to determine what is to be addressed by the assessment. During a C2 assessment problem formulation, the analytic problem is decomposed into appropriate dimensions such as: functions, mission areas, structures, command echelons, and C2 systems.

> Problem formulation is an iterative process that evolves over the course of the study. [This] phase should identify the context of the study (i.e. actors; threats; relevant previous studies; and political, social, historical, economic, geographic, technological environments) and aspects of the problem-related issues (i.e.

issues to be addressed, assumptions, independent variables, and constraints) (COPB for C2 Assessment, 54).

TW objectives are broken down into exceptional detail by decomposing each into the following categories for each initiative:

- Initiative Statement (a high-level description of the initiative's purpose)
- Objective (operational or technical capability to be produced
- Military Utility Assessment (MUA) Recommendation (recommendation that will be made to Military Utility Assessment Board if the objective is a success.
- Questions/Proposal (Specific aspect of the initiative to be addressed.
- Operational conditions required to produce valid data relevant to the question being asked
- Systems conditions required
- Information conditions required
- Attributes and measures that will be evaluated
- The data required to produce the assessment, which will produce the measures.

This step can take several months to complete because a typical TW can generate up to 150 separate initiatives. But when these questions are focused at the right level of detail, the rest of the event design is expedited.

A formal statement of the objective can be used to make the experiment more productive. "The statement of the [objective] should be formulated so as to specify the whole issue under study, not just the specific hypothesis under detailed analysis" (COBP-Experimentation, 129). This high level description will help the team identify all the elements within the objective and ensure that proper controls are in place. The COBP for Experimentation suggests that when writing an objective statement, it is important to ensure that, regardless of the result of the

experiment, the overall knowledge of the event is increased. This would require that the statement be written in such a way that it compares two outcomes. This typically requires the objective to establish a base line, or placebo, with which to compare the test case. Unfortunately real world experimentation is usually unable to create two identical situations in which to compare test and baseline results. The Trident Warrior experiments consider current systems, technologies, TTP, etc. as the baseline for experimentation.

Once the objectives have been outlined, the team can begin to develop the specific questions to be asked within each of those objectives. These questions will lead to attributes that need to be determined from the outcome of the experiment. Attributes will dictate what measures (data) should be collected during experimentation. The output from this step should provide the team with the required conditions, events, and data that must be collected to produce the required measures.

1. An Ideal Experiment

Although running an ideal experiment is impossible, many factors can be manipulated to make conditions as ideal as possible. An ideal experiment will control all sources of variation except the variable of interest. In order to do this, the objectives will require a theory that identifies limiting conditions, as well as the casual factors that influence the parameter/quantity of interest. Additionally, an ideal experimentation will measure all active variables and the limiting conditions precisely, correctly, and reliably.

According to the Code of Best Practice for Experimentation, an ideal experiment:

- Manipulates only one independent variable at a time,
- Observes change in only one dependent variable,
- Excludes, or controls for all relevant extraneous or intervening variables,
- Involves valid, reliable, precise, and credible measurement of all variables,
- Includes enough data collection opportunities to support the inferences needed to translate findings into actionable knowledge, and
- Generates findings, interpretations, and insights.

In an ideal experiment, we are trying to manipulate a single variable and measure its impact on another single variable in order to draw a cause-effect relationship. Again, in real world situations ideal conditions are sometimes not feasible. Real world experimentation attempts to run a larger quantity of experiments in order to observe and account for the influence of outside factors. If the experimentation team is not cautious, variables are inadvertently manipulated, outside variables cannot be controlled, or the desired variable is not effectively measured. These instances can change an experiment's expected outcome, and possibly detract from the general knowledge base on the subject matter.

> Bad experiments, which cloak weak or false knowledge in an aura of science, will make mischief, not music. At a minimum, they will slow the process of understanding the impact of innovation on transformation (by forcing other research and experimentation to learn and demonstrate that they are wrong) and cost money (by encouraging investments that will not pay off as expected). At a maximum, bad experiments well lead to flawed mission capability packages that fail in the field. (COBP-Experimentation, 140)

C. CONCLUSION

Once the experimentation team has defined the experiment's objectives, they can then begin to formulate specific questions. These questions have matching attributes that will provide linkage between the questions within the initiative and capabilities in the FORCEnet Concept or tasks in joint documents. The experimentation team will then determine what data should be gathered to validate these attributes and answer the questions.

Additionally, each objective will need to specify the overall conditions under which this data will be gathered. In the following step, the initiatives will be diagramed and checked to ensure that all of these components are complete and correct.

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VI. PROCESS DIAGRAMS

Phase	1	2	3	4	5	6
Due Dates	Pre-CDC	CDC	Pre - IPC	Pre - IPC	Pre - MPC	Pre - MPC
Step	Establish Team	Concept Development	Technolegy / TTP Harvest	Asset Identification	Develop Experiment Objectives	IDEF / OSD / Process Action Maps
Required Product	Defined Names and R /R	Defines Experiment Scope and Focus Areas. Insure aligns with Naval Vision	Defines and Researches selected Tech and TTPs	Platforms IDed and Install Scheduled	Defines the So What and how to measure	Turns the Words into Design Diagrams

Phase	7	8	9	10	11	12	13
Due Dates	Pre - MPC	Pre-FPC	Pre - FPC	TBD	TBD	TBD	TBD
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Required Product	Lays out the Flow and Appicable Scenarios to Meet Objectives	Defines the Detailed execution Plan	Maps the Data to be Collected to the means	Insure Plan is Flexable to changing enviornment	Must be Quick and Good	Necks down Analysis to Assessment	Necks Down Assessment to DOTMLPF Recommendations

Figure 8. Process Diagrams

Modeling the individual objectives of an experiment will allow the team to analyze the various relationships within each focus area. Models highlight any inputs, variables, and processes when developing the experiment objectives.

Trident Warrior requires a high level IDEF0 model be developed for each objective that shows how the objective contributes to that initiative. For the objective level and below, more targeted models are to be employed, depending on the analytic intent of the objective. Multiple model types can be included within the different areas of research to maximize their effectiveness. The analysis team, modeling assist team and initiative leads

will determine which models best fit into each situation, and specify what models need to be constructed. Modeling is an important step in comprehending the experiment and its objectives and evaluating each objective for thoroughness.

A. QUAD CHARTS

In order to uniformly and effectively display the many objectives within each experimentation campaign, the Trident Warrior team has developed its own design diagram, called a Quad Chart. A Quad Chart should be organized for each objective within the experiment, and will "display all pertinent information about an objective's purpose and requirements, provide an easy to examine display, in a format that can be used for presentations, and provide easily visualized information that can be edited and corrected before more detailed planning and FIRE input" (TW-05 Short Planning Directions, Appendix A). A Quad Chart is useful because it is a method of describing an entire objective in a single diagram.

A header should be above the Quad Chart, containing a one sentence initiative statement and the point of contact for that initiative. The first quadrant should define the objective with a single, over-arching statement of the objective's goal of what is to be learned or accomplished. The second quadrant should define the recommendations that will be presented to the Military Utility Assessment (MUA) Board if the objective is successful. Together, the objective statement and the MUA recommendation describe what is to be accomplished within this objective. The third quadrant should contain the questions or proposals that would support the objective and MUA recommendation.

Multiple questions may be required per objective. The collective set of answers to these questions will provide the information to be produced for this objective and its MUA board.

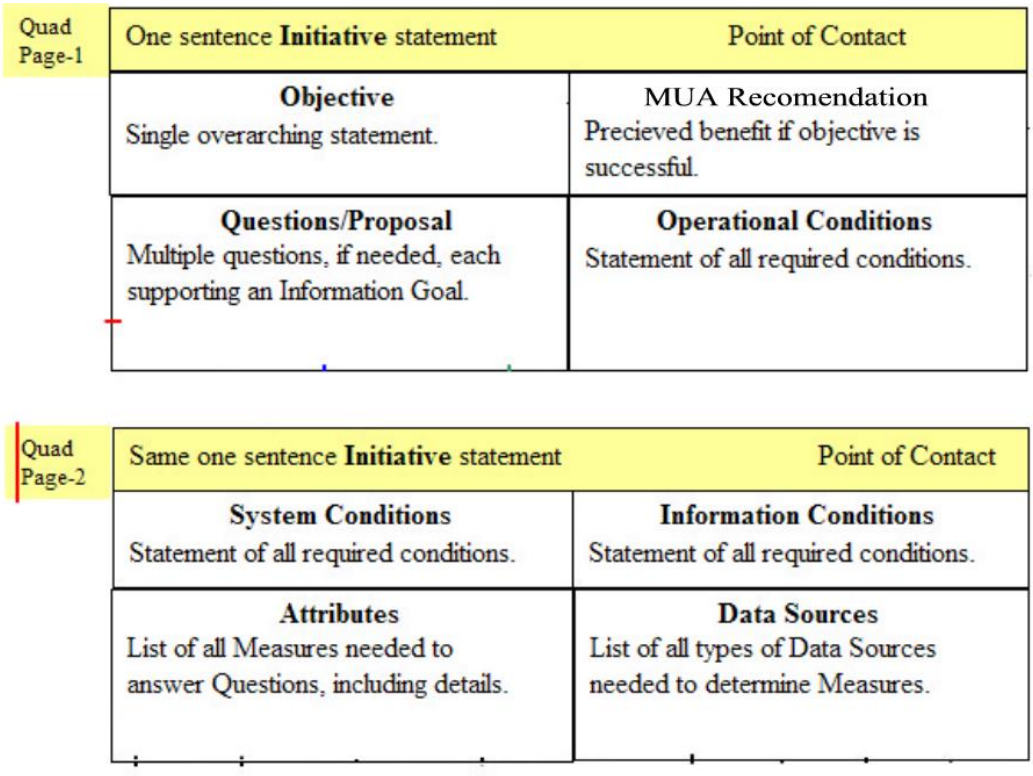

Figure 9. Quad Chart

Quadrants 4 through 6 will gather general conditions to frame the situations and collect the correct information. The fourth quadrant will contain a statement of all the required operational conditions, specifying which people or organizations will be responsible for conducting the operations within the objective. The fifth quadrant will contain a statement of all the required system conditions for this objective. The sixth quadrant will contain a statement of all the required information conditions for this objective, covering information type, load, protocols, distribution, etc. The seventh quadrant

will provide a general description of the attributes required to answer the questions or meet the proposals in quadrant 3. Finally, quadrant 8 will list all the data sources needed to determine the measures in quadrant 7. This will include whether the data is subjective or quantitative, as well as whether this data will be recorded electronically, through chat logs, in observation logs, or through surveys.

B. IDEF MODELS

> IDEF or Integrated DEFinition language is the modeling technique used to model functional processes and corresponding information to support Functional Process Improvement. The Department of Defense selected the IDEF [model] as the technique for functional managers to use for function (activity) and information (data) modeling. IDEF0 was selected as the standard technique for activity modeling. (McConnelly)

IDEF0 is used to model the decisions, actions, and activities of an organization or system, in order to communicate the functional perspective of a system. IDEF0 models describe the functions that are performed as well as what is needed to perform these functions. The basic structure used in IDEF0 modeling is the referred to as the ICOM format. ICOM stands for Input, Control, Output, and Mechanism. The center square of the ICOM represents the activity, or the function to be accomplished. Inputs are all the things that will be transformed by the activity, including materials and information. Controls are elements that govern or constrain the activity, including budgets and policy. Output is the result of the activity. Mechanisms are the elements that take part in or support the activity, to include people, systems, and facilities.

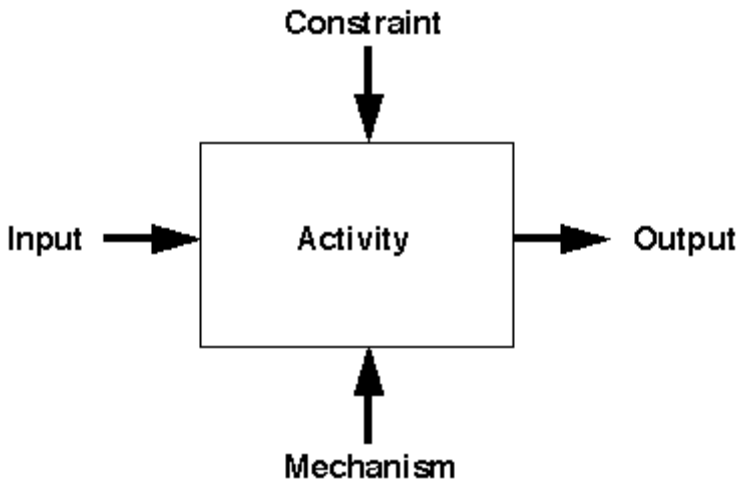

Figure 10. Generic ICOM for an IDEF0 model

Constructing a Context Diagram is the most basic element of the IDEF0 function modeling method and will represent the function at its highest level, limiting the scope of the model. A functional decomposition of the Context Diagram will produce the major activities required to complete the activity described in the Context Diagram. IDEF0 modeling is an iterative process and should be continued until reaching the level of detail that is desired. Subsequent models can continue to be broken down, with the new models in each level explaining actions required to complete the actions of the previous level. This process will continue until the IDEF0 model has been decomposed into its simplest state. Based upon this decomposition, it will be possible to determine if any inputs, controls, outputs, mechanisms, or relationships within the experiment were overlooked. Then it may be necessary to update the context diagram to include these changes.

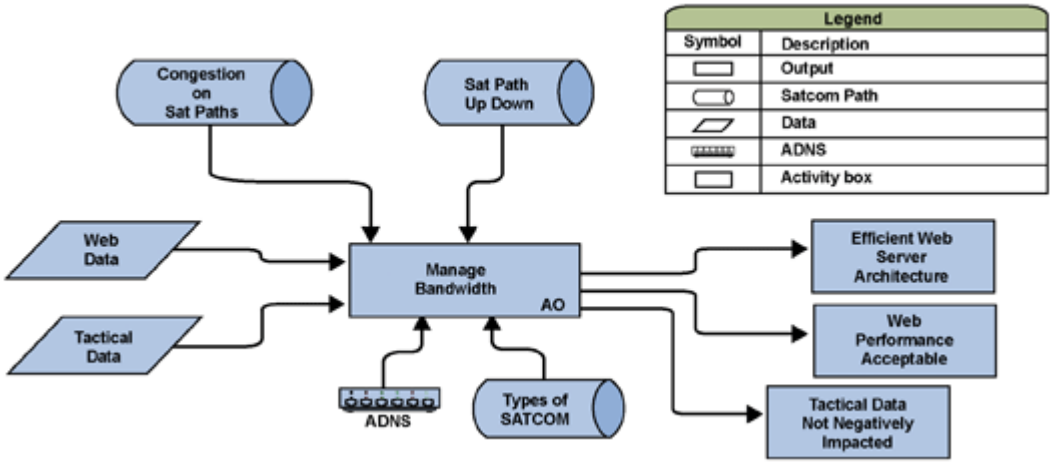

Figure 11. A Context Diagram for Bandwidth Management Objective (from: TW '05)

C. OPERATIONAL SEQUENCE DIAGRAMS

The functional decomposition of IDEF models can produce a complex output with multiple layers of information. These layers of information can sometimes be confusing and difficult to follow. Operational Sequence Diagrams (OSD) provide a single page, flow chart view of relationships between organizations, people, and/or technologies involved in a task. An OSD is essentially a flow chart that has been applied to a functional process to model the sequence of data or information as it flows through the system. An OSD can then be used as a planning tool or an analysis tool when developing an experiment.

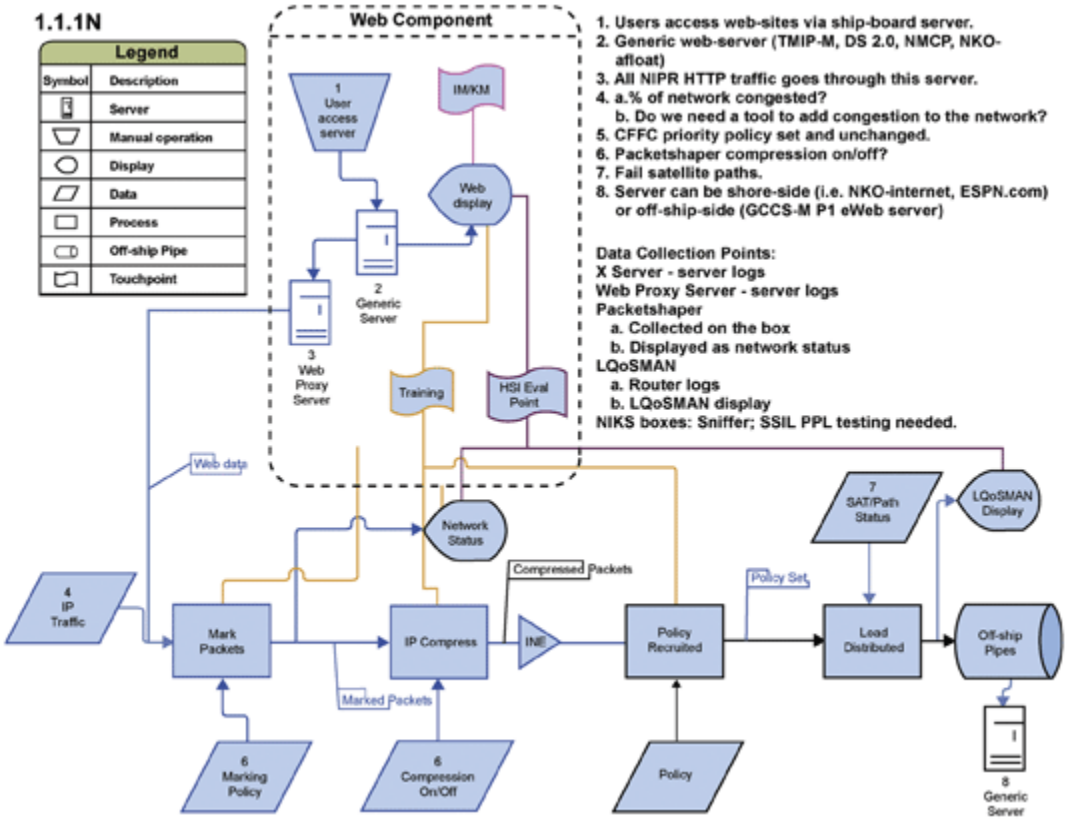

Figure 12. OSD Model for Bandwidth Management Objective (From: TW ’05)

D. CONCLUSION

Without these diagrams, it is possible to overlook relationships that may factor into the scenario. By drawing process diagrams for each objective, the experimentation team hopes to ensure that each objective is complete and correct. This includes the questions involving the desired attributes of each objective, the data needed to answer these questions, and the overall conditions that this data will need to be collected under. The following steps will designate specific scenarios to set the conditions for each objective and set up a comprehensive schedule for actually running the experiment.

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VII. EXPERIMENT DESIGN/EVENT DEFINITION

Phase	1	2	3	4	5	6
Due Dates	Pre-CDC	CDC	Pre - IPC	Pre - IPC	Pre - MPC	Pre - MPC
Step	Establish Team	Concept Development	Technolegy / TTP Harvest	Asset Identification	Develop Experiment Objectives	IDEF / OSD / Process Action Maps
Required Product	Defined Names and R /R	Defines Experiment Scope and Focus Areas. Insure aligns with Naval Vision	Defines and Researches selected Tech and TTPs	Platforms IDed and Install Scheduled	Defines the So What and how to measure	Turns the Words into Design Diagrams

Phase	7	8	9	10	11	12	13
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Figure 13. Experiment Design/Event Definition

A. EXPERIMENT DESIGN

The product of experimental objectives development provides the team with the overarching focus area, the major initiatives within the focus area, and the objectives that support those initiatives. The objectives will now be aligned with specific questions that identify the attributes to be gathered by the experiment. An attribute is a general characteristic that can apply to any number of tasks, systems or processes. This enables attributes to provide the link between the objectives. An attribute is associated with a certain capability, which is expressed as a single word (i.e. timely, flexible, redundant). This

characteristic can be desired or undesired. In order to determine the attribute for an objective, specific measures must be taken. These measures comprise the data that is collected. Thus, data is collected to determine the measures and answer the questions, which describe the objectives that comprise the initiatives, making up the overarching concept of the experimentation campaign.

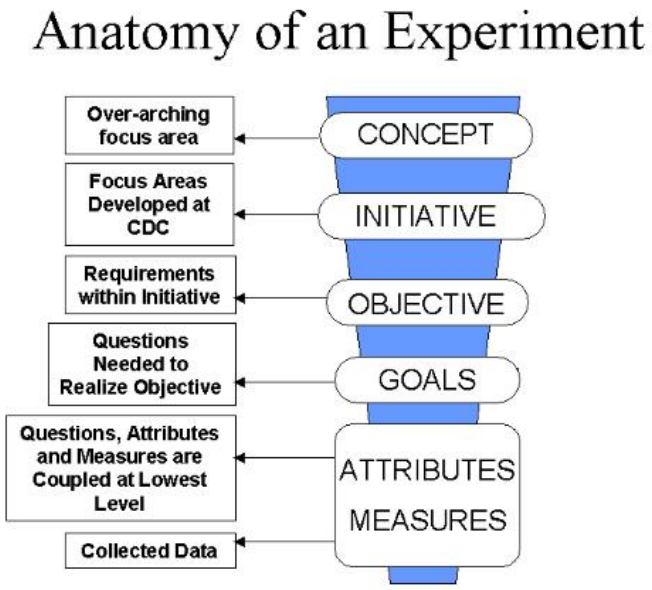

Figure 14. Breakdown of an Experiment

For example, if one focus area of an experiment is defined as mission planning, a possible experimental objective could be to develop the tools to support planning. The experimentation team may prepare a number of questions or goals that need to be achieved in order to satisfy this objective. A list of possible goals/questions for this example could be: (1) Provide rapid reach-back, (2) Provide Complete Information, (3) Provide a consistent Common Operating Picture (COP), and (4) Provide easy

collaboration. When these goals/questions are stated, it becomes easy to determine the attributes required to meet each goal and satisfy the objective. The attributes for this example would be: (1) rapid, (2) complete, (3) consistent, and (4) easy. The first three objectives are not difficult to comprehend, and only the fourth goal would require further explanation. The measures required to validate these attributes can now be determined. It is easy to become distracted with the naming of attributes, while the real focus should be on the measures. In order to validate the first attribute (rapid), it might be necessary to measure the quantity of time required to receive information from a system. This measurement should be defined as the interval of time between submitting a request for information and the receipt of that information. Measurements can also be subjective, but it is usually more convenient to put this subjective observation on a quantitative scale (i.e. on a scale of 1-5, how comfortable were you with the subject matter, with 1 being not comfortable, and 5 being very comfortable). This method allows the experiment to collect subjective data, and the analysis team to perform a quantitative analysis. This subjective measurement, or the measurement of the time delay in the previous example, is the actual data discovered by the experiment.

Once the details of the objectives have been established, the experimentation team can now begin to combine these objectives into a single experiment with unique scenarios that will produce the desired operational conditions, systems conditions, and information conditions. The Code of Best Practices for C2 Assessment defines a

scenario as “A description of the area, the environment, means, objectives, and events related to a conflict or a crisis during a specified time frame suited for satisfactory study objectives and the problem analysis directives.” A scenario should represent a plausible real world situation that would reflect the factors that are needed for each objective. Scenarios may also require smaller vignettes in order to produce all of the required conditions for each objective. “A vignette is primarily used for smaller scenarios, particularly as excursions from the main scenario” (COBP-C2 Assessment, 167). The scenarios and vignettes set the conditions and restrictions for each objective. These conditions allow comprehensive analysis and create a structure where the results of the analysis can be understood and interpreted. “The purpose of scenarios is to ensure that the analysis is informed by the appropriate range of opportunities to observe the relevant variables and their relationships” (COBP-Experimentation, 200). Scenarios must be selected, crafted and adapted to ensure that they support the objectives of the experiment.

“The use of a single scenario, even one that has been carefully crafted to focus on the key issues of an experiment, invites suboptimization and narrows the range of applicability for the findings” (COBP-Experimentation, 221).

B. EVENT DEFINITION

1. Measures of Effectiveness

In its simplest form, military experimentation tries to evaluate operational capabilities. In order to perform

these evaluations, previous experimentation teams have used descriptions of Measures of Effectiveness (MOEs) and Measures of Performance (MOPs). The Defense Acquisition University defines a Measure of Effectiveness (MOE) as "a measure of operational success that must be closely related to the objective of the mission or operation being evaluated," and Measures of Performance as "measures of a system's technical performance expressed as a distinctly quantifiable performance feature (i.e. speed, payload, range, time, or frequency)."

When attempting to relate MOEs and MOPs to specific items within the experimentation process, these definitions can be confusing. MOEs are always a higher level of measurement than MOPs, but exactly what they are describing depends on the context. Within our previous example of developing the focus area of mission planning with an experimental objective of developing tools to support planning, there are multiple ways of naming MOEs and MOPs. The initiative of mission planning could provide a Measure of Effectiveness that would describe the overall quality of the mission plan. Under this MOE, a possible MOP would be provided by the objective in a measurement of the quality of the planning support tool set. However, other potential MOEs are available. The attributes within each goal could provide a Measure of Performance. Within this example those measures would be rapidity, completeness, consistency, and ease. Similar to the attributes these measures were developed from, the fourth MOP would be the most difficult to comprehend.

Another option for the Measure of Effectiveness (MOE) would be the experimental objective. Listed in the last

example as a MOP, this measure could describe the quality of the planning support tool set. The MOPs under this MOE would be the measures of rapidity, completeness, consistency, and ease, as described by the attributes. Regardless of which option is chosen, the nomenclature must remain constant through the experiment. If MOEs are determined at the initiative level, it must remain that way across the experiment. MOPs abide by the same restriction, if MOPs are described by the attributes, it should be constant across the experiment.

The actual level within the experiment that the MOPs/MOEs define is context dependant. The Modular Command and Control Evaluation Structure (MCES) mandates that there be rigid boundaries between MOEs and MOPs, but it does not say where to establish those boundaries.

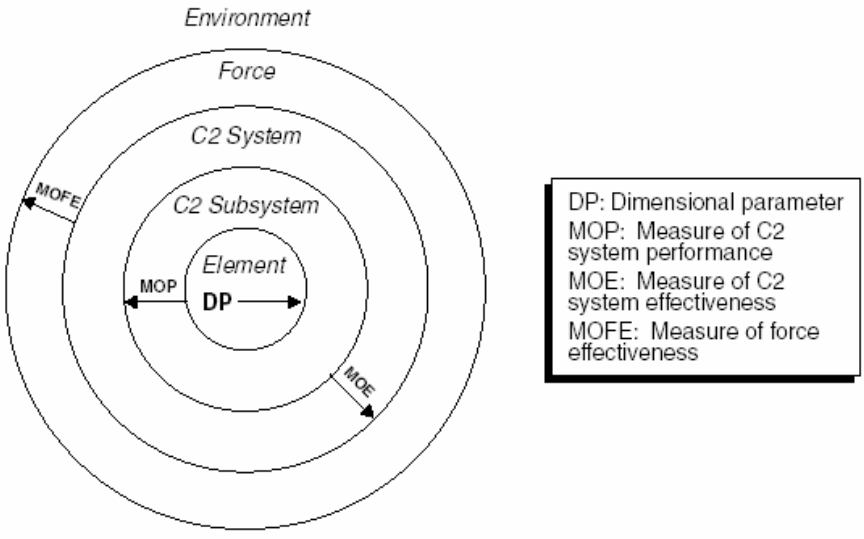

Figure 15. Relationships Among Classes of MOMs (from: MCES)

The terms MOE and MOP were developed to provide insight on the experiment, but they may actually cause more confusion than insight. It is possible to describe the

experiment using only initiatives, objectives, attributes and measures.

2. Master Sequence of Events List

Once a list of desired objectives with corresponding scenarios is produced, along with a list of desired measures to be collected, the experimentation team will begin to layout a schedule of events for the actual experiment. This schedule of events is called a Master Sequence of Events List (MESL). The MESL will combine the experimentation campaign's multiple scenarios together with the schedules for the participating assets, to produce a document that delineates a time and flow for all of the major activities within the actual conducting of the experiment.

The MESL must first consider the schedule of the assets that will be participating in the experiment. Within Naval experimentation, this schedule will include time in port, time spent in transit, and time on station. Additionally, this schedule will include time for specific events such as flight operations and crew watch-standing rotations. The experimentation team will have limited control over these aspects of the schedule.

Next, the MESL should consider the various scenarios required to complete the experiment. Occasionally, multiple scenarios can be run at the same time, but great caution should be taken to ensure that they do not conflict. The various scenarios should be scheduled in an orderly fashion, and should not impose undue levels of stress upon the ship and its crew. The conditions required to answer the each question need to be present at least

once within the running of the experiment. Ideally there would be multiple opportunities to complete each objective. Scenarios that correspond to higher priority objectives should be run earlier in the schedule, permitting them to be bumped down in the case a conflict. If higher priority scenarios are not run when scheduled and no excess time is available, a decision will have to be made on which lower priority objectives/scenarios can be omitted. The objective of the MSEL is to answer all of the questions for each objective within the given timeframe.

C. CONCLUSION

Once the overall plan for the experimentation campaign has been laid out, the team will begin to grasp the volume of the task they are undertaking. It is important that every scenario has been laid out in specific detail. Concentrating on one detail at a time and not becoming overwhelmed by the sheer volume will see the experiment to completion. Once the scenarios are defined and developed in detail, the experimentation team can begin to concentrate on how and where the individual pieces of data will be collected.

VIII. DATA COLLECTION PLAN

Phase	1	2	3	4	5	6
Due Dates	Pre-CDC	CDC	Pre - IPC	Pre - IPC	Pre - MPC	Pre - MPC
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Step	Experiment Design	Event Definition	Data Collection Plan	Execution	Final Report	Assessment OAA	MUA
Required Product	Lays out the Flow and Appicable Scenarios to Meet Objectives	Defines the Detailed execution Plan	Maps the Data to be Collected to the means	Insure Plan is Flexable to changing enviornment	Must be Quick and Good	Necks down Analysis to Assessment	Necks Down Assessment to DOTMLPF Recommendations

Figure 16. Data Collection Plan

A veteran experimenter will require only a quick glance at the Trident Warrior Experimentation Process to realize that no specific step is included to analyze data. This is a very dangerous omission, as it does not express the significance of the Data Analysis Plan. Within Trident Warrior, the Data Analysis Plan (DAP) is written in conjunction with the Data Collection Plan (DCP), creating a Data Collection and Analysis Plan (DCAP). This is done immediately following the Mid-Planning Conference (MPC), approximately 4 months before the actual experiment.

A. DATA ANALYSIS PLAN

> What makes Trident Warrior different from other naval assessment events is the level of detail of the analysis [planning]. That level of detail can be attributed to the Trident Warrior Process. The strict compliance to this process is what ensures event consistency and allows us to maintain a high standard in our FORCEnet assessments. CAPT Chris Abbott, director of FORCEnet Innovation and Experimentation. (Poeltler and Gallup, 29)

While it may seem obvious that data must be collected before it can be analyzed, it is not so clear that you must know how the data will be analyzed before you can know what data to collect. By preparing the data analysis plan before, or in conjunction with, the data collection plan, the experimentation team ensures that only relevant, useful data is collected. "In economic terms, the data analysis plan acts as the source of demand. The data collection plan acts as the source of supply" (NATO COBP for Experimentation, 224). Without the data analysis plan, it becomes very tempting to simply collect the data that is easiest to access, rather than the data that is most influential to the experiment. In order to provide the necessary data, the data analysis plan must be linked to the data collection plan, the post-experiment modeling plan, and the material necessary to revisit, revise, and perhaps extend the conceptual model underlying the experiment. This ensures that the data collected will be directly applicable to the overall purpose of the experiment.

The first step of data analysis is "to identify the independent variables and their measures, then the active variables and their measures, and finally the intervening

variables (including those that are to be controlled in the experiment) and their measures" (NATO COBP for Experimentation, 226). A quick glance will also show that much of the analysis is very in-depth, and it is often a requirement to have a statistical expert within the experimentation team. Analysis can be categorized into three general phases: descriptive analysis of individual variables, bivariate analysis of relationships, and multivariate analyses of larger patterns.

1. Individual Variables

Once the data has been converted into the form required for analysis and formulated into an integrated data set, the first analytic effort should be a descriptive analysis of each variable of interest. "These descriptive analyses are performed to (a) identify and correct data anomalies, (b) understand the distribution of each variable, and (c) identify any transformations of those variables with distributions that may make analysis misleading" (NATO COBP for Experimentation, 227). When identifying and correcting data anomalies, analysts should search for invalid or illogical data. The Data Analysis Plan should include time to research these anomalies in the original records and correct them. Uncorrectable data will need to be excluded from the data set. Next analysts should review the distribution of each variable, searching for variables that would cause an error within the analysis. Typical examples include variables that have a single value or variables that in only a small number of cases differ from a single value. These variables should also be removed because they will not be able to contribute to the differences in the variables of interest. Additionally, in this step analysts should search the data

for outliers, or small groups of data that are very distant from the bulk of the data. Outliers will make the application of simple linear statistics invalid unless they can be transformed (possibly using a log function), excluded using the creation of a new variable, or subdivided from the bulk data using a dummy variable. The last technique actually suggests that the data is from a bimodal distribution.

2. Bivariate Analyses of Relationships

Bivariate relationships are typically considered to be little more than a building block for multivariate relationships. However, because most hypotheses are started in bivariate terms (IF A, THEN B, under CONDITION C), bivariate relationships comprise a majority of testable propositions. When attempting to identify relationships between various factors and variables, the order for conducting bivariate analyses is (NATO COBP for Experimentation):

1. Dependent variables;
2. Control factors
3. Control factors and dependent variables
4. Independent variables
5. Control factors and independent variables
6. Independent variables and dependent variables

Dependent variables are tested first in order to ensure that they are not correlated. If two dependent variables are strongly correlated, only one of them should be fully analyzed. This also means that the underlying conceptual model should be revisited because it incorrectly distinguished between two factors that were closely associated. Variables with modest levels of bivariate correlation should be kept in the model and analyzed

separately, as they could prove important in building a comprehensive model.

If a strong relationship between control factors is found, one of them should be removed to save efforts in analyzing similar relationships.

By examining the relationships between control factors and dependent variables, analysts can quantify the effectiveness of the experiment. In a well-designed experiment, control factors have no direct impact on the data from the experiment. A major problem in most human subject experiments is learning through repetition, and an experiment should be designed to limit this.

Next the analyst should check for correlation between the individual independent variables. Most analytic tools assume that the independent variables are unrelated, and thus, having correlated independent variables will yield false statistical explanations. Correlated independent variables will be handled in the same manner as previous variables: they can be combined, they can be analyzed separately, or one of them can be thrown out.

Similar to the relationship between control factors and dependent variable, the relationship between control factors and independent variables could indicate a flaw in the experimental design or in the conceptual model. A correlation between control factors and dependent variables does not necessarily contaminate the data, but this correlation should be considered when conducting the multivariate analyses.

Finally, the purpose of the experiment is to examine the relationship of the independent and the dependent

variables. These tests of correlation provide direct answers to the hypothesis posed in a conceptual model.

3. Multivariate Analyses

The multivariate analyses are the end effort to examine the data in the full affects of the surrounding environment. After running all of the individual bivariate analyses, the experimentation team has ensured that the effects on the dependent variables come as a direct result of a change in the manipulated variable. Ideally, this will allow the experimenters to draw a cause-effect relationship between the two variables.

B. DATA COLLECTION PLAN

"The data collection plan includes all the variables to be collected, all the places where they are collected, all the means of collection, and all the places the data will be stored for processing" (COBP for Experimentation, 241). The data collection plan is required to be simultaneously very broad and also very specific. It must not only specify who, when where, and how all data is to be collected, but it must also cover all training and support required, proficiency standards and quality control. A plan for the archiving and processing of raw data into a form that can be processed by the data analysis plan must also be included. The key steps of a data collection plan include (COBP for Experimentation, 242):

- Specifying the variables to be collected,
- Identifying the collection mechanism for each variable,
- Ensuring access for collecting each variable,
- Specifying the number of observations needed for each variable and checking to ensure they are expected to be generated,

- Identifying the training required to ensure quality data collection,
- Specifying the mechanisms to ensure data capture and archiving, and
- Defining the processes needed for data reduction and assembly.

In addition to this sequence, there are also multiple ways of collecting the data: automated collection, recording for later reduction, surveys, subject testing, and human observation.

1. Automated Collection

As experiments, particularly in the Command and Control functions, become increasingly automated, it becomes more convenient to automate the data collection as well. Typical automated collection focuses on system loads; workstation loads; system, workstation, and application usage; as well as a comparison between test subject's perceptions and the "ground truth." The data collection plan must specify where and when this data will be collected, how the data can be collected without affecting the experimentation scenario, how to synchronize the data collection and the experiment, and where the data will be archived.

2. Recording for Later Reduction

Due to the limited supply and abilities of human observers, experimentation teams often rely on audio or video recordings to supplement their data collection process. Unfortunately, even recordings are not always a thorough means of capturing all of the events within an experiment. There is the possibility of catching one side of a conversation, the test subject stepping out of camera or microphone range, and any number of technical problems with the recording equipment. Unless the experimenters are

properly prepared for the recording process, the material they record will likely be incomprehensible, inadequate, or incomplete.

3. Surveys

Surveys are popular data collection tools because they are easy to review and can be used in multiple ways. Surveys can be used to gain knowledge about potential subjects. Subjects can be tested on their expertise, familiarity with the equipment, and their familiarity with other subjects. Subjects can also be surveyed during the experiment to determine their perceptions, knowledge, ideas, understanding, attitudes, insights, and situational awareness as they are being tested. The experimentation team can also be surveyed during the experiment to gather their insight on how well the systems are performing and how they can be improved.

Surveys can pose problems within an experiment. A survey can lock the experimentation team into only observing the predetermined items that were mentioned in the survey. To combat this problem, it is good to include some open-ended questions in your survey that ask the subject for additional reactions and observations. Another potential problem is that surveys required time. Subjects will require additional time to complete surveys, and this time must be scheduled into the master sequence of events list. The only way to determine how much time is necessary to complete the survey would be to pretest the survey using similar respondents. Using the experimentation team to pre-test the survey will not provide adequate time for the less familiar test subjects to complete the survey. Precise attention must be paid to the wording of surveys.

Misunderstood or confusing questions will not provide the data desired. If a survey is conducted within multiple phases of an experiment, it will tend to impact future behaviors. In order to prevent the data from reflecting this "learning curve" by the subjects, it is sometimes beneficial to show the subjects the survey before the first phase of the experiment. The experimentation team should also realize that a poorly structured survey creates unnecessary work on the data analysis team. Multiple choice or scaled questions are easier to process analytically. Surveys can be a very effective means of gathering data that would be otherwise unobservable, but due to the many risks, any experimentation team using surveys should include a team member with expertise in survey design and procedures.

4. Subject Testing

Subject tests are generally used to gather information on proficiency or personal characteristics. "Proficiency tests are used when the results of the experiment are expected to depend, at least in part, on the particular skills of the individuals or teams participating. If proficiency is a control or is being used to assign subjects in order to control it out of the experiment, testing will be needed" (COBP for Experimentation, 249). In this situation, it is beneficial to not release the scores of the proficiency test to the subjects until after the experiment.

Subject tests are also used to test for personal characteristics. Typical characteristics tests, such as IQ or personality tests, should be chosen from tests that have already been published and validated. There is no reason

for the experimentation team to attempt to reinvent these tests and possibly give the experiment suspect credibility. These tests should be administered professionally. Data from these tests should not be linked with the individual subjects through processing.

5. Human Observation

a. Observer Selection

Observers are a key part of the data collection process and should have an appropriate background with respect to the experiment's focus. Observers should have some proficiency at observation and additional training should be available. Within Trident Warrior, observers are typically underway on vessels, and it is important that they blend in with their environment and do not cause an unnecessary distraction. Observers must be proficient in knowing what type of data they need to collect and how to collect it. It is not uncommon for an observer's shift to exceed 8 hours, and therefore, observers should be physically fit and capable of handling the stress of their job.

b. Observer Scheduling

Observer scheduling and positioning is a key issue. Time should be scheduled for additional training and familiarization. It is good to incorporate additional time into the schedule for observers to review their notes and format the data for analysis. It is also a good idea to have extra observers available. When they are not observing, they can be used in a quality control function.

C. CONCLUSION

Typically, the DCAP should be published well before the beginning of the experiment, in order to provide the experimentation team and observers time to familiarize themselves with the plan. However, within Trident Warrior, access to FIRE permits everyone to view the individual elements that will make up the DCAP, allowing the team to shorten the timeline and make changes to the DCAP right up until the last minute.

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IX. EXECUTION

Phase	1	2	3	4	5	6
Due Dates	Pre-CDC	CDC	Pre - IPC	Pre - IPC	Pre - MPC	Pre - MPC
Step	Establish Team	Concept Development	Technolegy / TTP Harvest	Asset Identification	Develop Experiment Objectives	IDEF / OSD / Process Action Maps
Required Product	Defined Names and R /R	Defines Experiment Scope and Focus Areas. Insure aligns with Naval Vision	Defines and Researches selected Tech and TTPs	Platforms IDed and Install Scheduled	Defines the So What and how to measure	Turns the Words into Design Diagrams

Phase	7	8	9	10	11	12	13
Due Dates	Pre - MPC	Pre-FPC	Pre - FPC	TBD	TBD	TBD	TBD
Step	Experiment Design	Event Definition	Data Collection Plan	Execution	Final Report	Assessment OAA	MUA
Required Product	Lays out the Flow and Appicable Scenarios to Meet Objectives	Defines the Detailed execution Plan	Maps the Data to be Collected to the means	Insure Plan is Flexable to changing enviornment	Must be Quick and Good	Necks down Analysis to Assessment	Necks Down Assessment to DOTMLPF Recommendations

Figure 17. Execution

A. BEFORE THE EXPERIMENT

1. Data Collection

Whenever possible, the experimentation team should collect any available, pertinent data before the experiment begins. This is typically limited to background and expertise of the test subjects. Determining differences between subjects can ease data analysis and lend credibility to the experiment. It is important to archive this data immediately, and not become distracted by the upcoming experiment. If the data is not archived before the experiment starts, there is a good chance that it will become lost in the shuffle. Data should always be saved in both raw and processed forms. Raw data will permit the

analysis team to review the data, recreate the scenario, and even fix corrupted or incorrectly processed data. Whenever dealing with personal data, it is important to ensure that all personal information will be kept private.

> Privacy protection is an important element that cannot be overlooked. It is imperative that the subjects understand that they are not being evaluated (the systems, doctrines, organizational innovations, under study are being assessed, not the subjects) and that no links will be made from individual participants to scores and/or results. Not only must the understand this, but they must also be confident that this is true. Failure to instill this confidence can result in distorted results. (COBP for Experimentation, 259)

2. Training

a. Observers

Most data cannot be collected using an automated collection program, and, therefore, will require the use of observers to be recorded. Observers must understand why they are collecting data, and what purpose that data will serve. Explaining any underlying methodologies and theories will empower the observer and significantly increase their understanding and data collection abilities.

A training program should be created that focuses on when, how and where the data is to be collected. Observers should be familiarized with the processes affiliated with observation, surveys, questionnaires, and instrumentation, in accordance with the Data Collection and Analysis Plan. Observers should be given live scenarios in which they can practice. A proficiency test, comprised of a written exam and a practical exam, should be administered. The written exam should test the observer's knowledge of the fundamentals, while the practical exam

should present the observer with a scenario that will test their ability to correctly collect and code data. If necessary, a scheduled review session should be conducted.

b. Subjects

Military experimentation typically compares the current Doctrine, Organization, Training, Materiel, Leadership, Personnel or Facilities (DOTMLPF) with a proposed alternate solution. The subjects will be more familiar with the current DOTMLPF than the proposed alternative, giving it an unfair advantage. New systems require the greatest quantity of "familiarity training." Subjects need to know how they interface with the new system, what tasks it performs, how it performs them, how the system uses the underlying data, what operations the system performs on the data, how the data is displayed, and the sources of the data (COBP for Experimentation). Subjects will need to understand their roles and duties within the experiment. As done with the observers, a proficiency test should be given to test the subject's familiarity with the proposed DOTMLPF solution. Initial training of subjects and observers should proceed independently, but a final segment of training should be run with the observers gathering data on the subjects, as the subjects run through a scenario.

B. CONSIDERATIONS FOR OBSERVERS

Observers can be utilized as either silent observers or to administer surveys and questionnaires. Regardless, it is imperative that they do not influence the outcome of the experiment by engaging the subjects in conversation, expressing opinions, or interfering with the experiment in

any other way. They must not provide hints or suggestions, even when something has been overlooked.

> Incidents will occur where failure to provide certain information could cause the experiment to go drastically awry. To account for those instances, procedures should be established for the observers/controllers to get advice from the senior member of the observation team who, in turn, should confer with the experiment director and senior controller. (COBP for Experimentation)

Only experiment controllers, and not observers, should answer questions or offer any item of substance concerning the experiment.

An observer's shift should never exceed 8 consecutive hours. A fatigued observer will not be able to collect pertinent data with the speed and accuracy of a well-rested observer. It is important that different observers code data in the same manner, so as to prevent confusion when the data is processed. Observer shifts should be well planned, and should ensure that no data is lost during handoff. Observer shifts should occur on different schedules from the subject's shift changes. This will allow the observer to note the process and exchanges between subjects.

The Data Collection Plan should describe how comprehensive the observer must be and should specify which areas need to be covered in great detail. Otherwise, the observer will become overwhelmed, attempting to collect more data than is manageable.

Data collectors and observers should be constantly supervised. Their collected data should be checked for completeness and confidence in its validity. Observers

should be discreetly alerted, without notifying the subjects, of events likely to affect their station. This will often result in the need for regularly scheduled meetings and timely interaction.

C. DATA COLLECTION AND PROBLEM SOLVING

> Automated collection systems and instrumentation can fail, humans bring their own backgrounds and foibles to the program and, regardless of training, some will try to collect what they feel is interesting, rather than what they are assigned to collect. To ensure the success of the experiment, it is imperative that data collectors be supervised and a quality control mechanism is in place to ensure that the necessary data is being collected. (COBP for Experimentation, 268)

1. Automated Data

Automated data can be taken from screen captures, email archiving, requests for information, and database snapshots by using a simple computer program to dissect this data and immediately archive it. Unfortunately, because it is so easy to use, problems with automated data collection often go unnoticed. This data must be validated at regular intervals to ensure that the expected data is being processed in the expected manner. The validation interval should vary with respect to the data flow rate. Additionally, the ease with which this data can be collected could lead the collection team to gather large amounts of unimportant, unexpected data, overwhelming the data analysis team.

2. Loss of Personnel

One of the most difficult obstacles for an experimentation team to overcome is when a key individual is unable to participate in the experiment. Most commonly,

this lost participant was scheduled as either a test subject or as an observer. Whenever possible, it is a good idea to run extra iterations of the experiment, so that a fault in one run will not bring the entire experiment to a halt. It is also a good idea to train extra participants so that test subjects are replaceable. Additionally, it may be wise to schedule extra time to train these replacement subjects on the DOTMLPF solution being analyzed. Finally, if no other options are available, the experiment may have to continue shorthanded. The loss of manpower may affect performance, and this should be accounted for in the data analysis.

In the case of an observer dropping out of the experiment, there are a few additional options. It would be convenient if there were extra observers on hand that could step in and fill the position. It might also be possible for a supervisor to take on the additional role of observer. It may be necessary to shift some observers from less important areas to fill the void.

3. System Failures and Data Contamination

The best solution to avoiding system failures is to design redundancy into the experiment and avoid single points of failure within the systems. All equipment should be tested prior to the beginning of the experimentation campaign. A common error with most system testing is not subjecting the systems to the same loads they will be forced to endure during the experiment, resulting in system failures. It is important to test the systems with the identical loads and traffic they will encounter during the experiment.

As with any experiment, the observation of test subjects will inherently cause them to work harder and strive to excel. Ideally this factor would be mitigated by the observation of teams on both the system (or idea) being tested, as well as the system (or idea) that is currently in use. Data may become contaminated due to members of the experimentation team influencing the outputs or even test subjects intentionally skewing the data. In any case, if data becomes contaminated, it is necessary to exclude this data from the analysis.

4. Premature Reporting

It is often very tempting to attempt to draw conclusions during the experimentation phase. Data analysis must always follow data collection and precede any type of reporting. The experimentation team cannot get off schedule and attempt to provide instant feedback on the results. "Instant feedback can be misleading and lead people to believe that they do not need to execute the data analysis plan" (COBP for Experimentation, 275). An attempt to provide immediate reporting tends to prevent good analysis and consistent results. It is very difficult to refocus a decision-maker's attention away from the immediate report, even when the data analysis proves the immediate report to be false.

D. DATA ARCHIVING

Before the data can be analyzed, it should be archived in its unprocessed form. Raw data will enable the experiment to be replicated and validated, thus permitting it to contribute to knowledge generation. The importance of preserving the raw data cannot be overstated, and it should be saved in more than one location and on more than

one medium. Additionally, all steps involved with processing and manipulating the data should be recorded, allowing the final analysis to be completely reconstructed.

The handoff of the data between data collectors/observers and the data processors/analysts can be a major point of failure within the experiment. Both the data collectors and the analysts should be involved in the conversion of raw data into the form required by the analysts.

> Data [processing] should occur as soon after the data collection as practical, preferably in the days immediately following the experiment. This has the benefit of performing the data [processing] while experiment events are still fresh in the minds of the data collectors. It also has the added benefit of having all the collectors together so that they can work as a team. (COBP for Experimentation, 273)

X. REPORTING RESULTS/CONCLUSION

Phase	1	2	3	4	5	6
Due Dates	Pre-CDC	CDC	Pre - IPC	Pre - IPC	Pre - MPC	Pre - MPC
Step	Establish Team	Concept Development	Technolegy / TTP Harvest	Asset Identification	Develop Experiment Objectives	IDEF / OSD / Process Action Maps
Required Product	Defined Names and R /R	Defines Experiment Scope and Focus Areas. Insure aligns with Naval Vision	Defines and Researches selected Tech and TTPs	Platforms IDed and Install Scheduled	Defines the So What and how to measure	Turns the Words into Design Diagrams

Phase	7	8	9	10	11	12	13
Due Dates	Pre - MPC	Pre-FPC	Pre - FPC	TBD	TBD	TBD	TBD
Step	Experiment Design	Event Definition	Data Collection Plan	Execution	Final Report	Assessment OAA	MUA
Required Product	Lays out the Flow and Appicable Scenarios to Meet Objectives	Defines the Detailed execution Plan	Maps the Data to be Collected to the means	Insure Plan is Flexable to changing enviornment	Must be Quick and Good	Necks down Analysis to Assessment	Necks Down Assessment to DOTMLPF Recommendations

Figure 18. Reporting Results

A. REPORTING RESULTS

1. Final Report

The Experimentation team should attempt to complete its final report on the experiment approximately three months after execution. The Final Report will be a complete documentation of the experiment.

a. Principle Results

The Final Report should consist of at least 4 major sections along with an executive summary. The first section should outline the principle results of the experiment. The principle results section should then be broken down into the different initiatives of the experiment, and each individual initiative comprising a

small section of the report. The layout should feature a short description on the conditions of experiment, followed by a short description of the quantity that was measured. This should be followed by the conclusions drawn from the measurement and straightforward recommendations that are suggested due to the outcome of this initiative. These initiatives should be grouped together with similar initiatives that fall under the same objective.

b. Background

Following the principle results section, the Final Report should now provide a brief history of the experiment. This should include a short history, an overview of activities within the experiment, a brief description of the experiment's overall concept, and an overview of the operations that took place within the experiment.

c. Initiative's Context

The initiative's context section should contain an overview of the conditions of the experiment quality, the context of the overarching focus area, and context descriptions of the experiment initiatives.

d. Experimentation Status and Recommendations

The last section of the Final Report should provide a general idea on the outcome of the experimentation campaign as a whole. It should include the general status of the experiment, as well as recommendations from each significant observation within the experiment.

Also included in the Final Report should be an executive summary that provides a quick overview of the information contained within the rest of the report.

2. Other Reports

a. Operational Agent Assessment

The Operational Agent Assessment (OAA) is a report that is unique to the Trident Warrior program. The culminating step of the experimentation process is a Military Utility Assessment Board, where a committee of high-level officers makes recommendations based upon the results of the experiment. In order to avoid subjecting the MUA board to a comprehensive Final Report, the Trident Warrior team drafts an Operational Agent Assessment. The Operational Agent Assessment is tailor-made especially for the MUA board, and streamlines the Final Report into a few comprehendible points on each major focus area within the campaign. The purpose of this report is to inform the high-level decision making of the MUA board. The OAA is drafted by the experimentation team, and then presented, along with the Final Report, to the MUA board by the operational agent sponsoring the experiment (NETWARCOM for TW).

b. Military Utility Assessment

Once the Final Report is complete, a Military Utility Assessment Board is convened to determine how the results and conclusions of the experiment will benefit the military and ultimately the warfighter. The Military Utility Assessment Board will publish the Military Utility Assessment that lists recommendations for changes to current Doctrine, Organization, Training, Materiel, Leadership, Personnel, and Facilities policy.

Within the Navy, the completed MUAs are then briefed to the Sea Trial Executive Steering Group, who will rate each recommendation with one of four possible outcomes.

The first possible outcome would be to classify the experiment results as providing a significant enhanced warfighting capability impact. It would then be presented to the Commander of U.S. Fleet Forces Command (CFFC) for immediate delivery, insertion into the Naval Capability Development Process (NCDP), or passed on to Navy Warfare Development Command (NWDC). A second possible outcome for a recommendation from the MUA would find the experiment results provide a positive enhanced warfighting capability impact. In this case, the recommendation would be forwarded to CFFC, and its progress would be carefully tracked. A third outcome would be to classify the experiment results as not mature and requiring further examination. The event would then be rescheduled for additional experimentation as warranted. The final option would be to classify the recommendation as not providing an impact, and the event would then be closed out.

B. CONCLUSION

The overall purpose of military experimentation is to provide a competitive advantage to the warfighter. By testing new technologies and innovative methods of employing them, the experimentation team hopes to prove or disprove the added benefit of their use. An experiment is not deemed a success even if the MUA board does not recommend the solutions being tested. Success is dependent upon running a comprehensive and effective experiment that highlights the various advantages and disadvantages of differing military doctrine, organization, training, materiel, leadership, personnel, or facilities (DOTMLPF).

The Trident Warrior process has successfully seen multiple experimentation campaigns to completion. By using a proven, reliable experimentation process, they have multiplied the experimentation campaign's chances of success, and also increased the reliability and confidence of others. "I have come to rely on Trident Warrior information and assessments" VADM James McArthur, commander NETWARCOM. Enabling decision makers to make informed, intelligent decisions on the future of the military is really what it is all about.

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APPENDIX A. TW-05 SHORT PLANNING DIRECTIONS

Conceptually, military operational experiment planning is simple. An objective is defined and that leads to measures, then to data collection needed to provide those measures. The experiment results provide a determination of the level off success with the objective. But, the devil is in the details. Careful planning is needed to ensure that results address objectives. If you wish to compare the capabilities of two systems, or processes, and test one under one set of conditions and the other under different conditions, useful comparisons will not emerge. Successful planning proceeds along well-defined steps, each producing an essential planning element. This document explains, briefly and simply, these experiment planning elements.

Planning an experiment is carried out in two phases:

Initiative planning is concept planning. It sets the overarching structure for the experiment, defines the goals, what is to be learned and what quantities are needed to do it.

Experiment planning provides experiment details: how it is to be carried out, what systems are to be used and where, specific data to be captured, where, and how that is to be done.

Initiative Planning Structure

An Initiative is described by a single sentence that applies to everything that is to be done under its umbrella. Each Initiative has a set of one or more Objectives, with each Objective containing the following components:

Objective Information Goal	This **pair** of elements describes what is to be accomplished
Questions	They are the bridge between Information Goals and Measures and Data
Conditions (3)	Specific conditions may be needed to match and address the Objective. They and Data to be captured lead to the MSEL.
Measures Data	Quantities that must be determined to answer the Questions. Types of Data needed to produce the Measures

The following will present planning structures and element descriptions, first with broad descriptions then increasing detail as the document proceeds. This presentation order is followed so that overarching understanding can be developed before a lot of detailed reading is done. The order of presentation is:

- Quad Charts – Initiative Elements
- Initiative Planning Components
- F.I.R.E. Initiative Input
- Threads and Numbering
- Quad Charts to F.I.R.E. Initiative Input Mapping
- Experiment Planning and Data Capture Plan
- Experiment Planning Components
- FORCEnet Attributes and Measures
- Planning Stoplights
- Amplifying Comments on Initiative Planning Components
- Amplifying comments on Experiment Planning Components

Quad Charts – Initiative Elements

There is a single set of two Quad Charts for each Objective. These Charts serve the following purposes:

- Display all pertinent information about an Objective's purpose and requirements.
- Provide an easy to examine display, in a format that can be used for presentations.
- Provide easily visualized information that can be edited and corrected before more detailed planning and F.I.R.E input.

There is a Quad Chart review process where they are scrutinized carefully to ensure congruence across the planning elements and their accuracy and sufficiency.

A Quad Chart's elements are (content descriptions are later in this document):

Header - Contains Initiative statement and POC.	The colors here are chosen to match those in the following FIRE input diagram. Yellow is used for three elements because of their close relationships.
Objective - 1st quadrant - One Quad set per Objective Info Goal - 2nd quadrant - This is the Objective's pair.	
Questions - 3rd quadrant - Multiple Questions allowed. Questions address the Info Goals.	
Conditions - 4th, 5th, and 6th. General rather than specific descriptions.	
Measures - 7th quadrant - General descriptions of Measures types. Units and other specifics not necessary.	
Data - 8th quadrant - General description of types of Data capture.	

Error!

There may be multiple Questions, Measures, and Data and the associations between them is not necessarily clear in the Quad Charts. When information is input to F.I.R.E., care must be taken to provide these associations. This is described in the later section on Quad Charts to F.I.R.E. input mapping.

F.I.R.E. Initiative Input

Placing the Initiative information in the F.I.R.E. knowledge management system serves the following purposes:

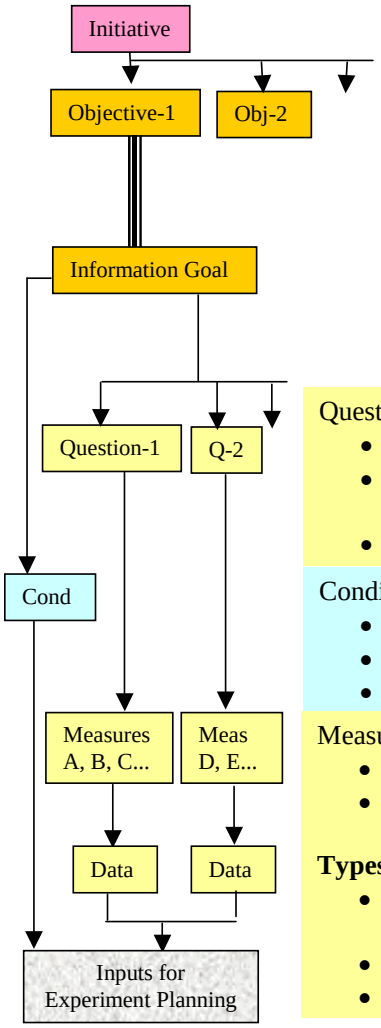
- Segment Initiative information input into experiment Threads that will be used for detailed planning.
- Provide additional detail over that in the Quad Charts to enable Experiment Planning.
- Archive information in a structure that provides easy association between elements for analysis and results production.
- Provide a structure for semi-automated results reporting.

The main differences between F.I.R.E information and the Quad Charts are:

- F.I.R.E. segments Questions into individual Threads.
- Conditions, Measures, and Data descriptions are more detailed in F.I.R.E.
- Conditions may be more specific in F.I.R.E. to relate to their specific Question.

- Multiple Measures and Data specifications are sorted into those that apply to a specific Question.

F.I.R.E. Initiative Input



One sentence statement of Initiative's **Purpose** during this experiment. There will be several Initiatives.

One sentence statement of specific Objective **Goal** that supports the Initiative's Purpose.
- An Initiative will contain several Objectives.
- Goals may relate to operational capabilities.

Types of Information needed to address the Objective Goal.
- Only one Information Goal statement per Objective.
- More than one type of information may be required.
- Includes guidelines to Conditions.

Questions provide links between Objectives/Information and Measures.
- Several may be needed to link to all required Measures.
- The collective set of answers will provide the Information to be produced for that Objective.
- A Question statement must lead directly to Measures.

Conditions: **situations** to must be set up to obtain the correct Information.
- **Operational** – people/organizations conducting the operation
- **System** – which ones and their state
- **Information** – what, load, protocols, distribution, etc.

Measures are specific **quantities** to be produced to answer the Question.
- Included are appropriate units.
- Whether they are subjective or quantitative is stated.

Types of Data to be obtained, not details of where, when, and how.
- Stated whether electronic, human information logger, survey, Chat log, etc., are to be obtained.
- State whether subjective or quantitative.
- Operational units at which Data is to be gathered.

Threads and Numbering

Planning Thread: a complete set of definitions, Initiative through Question. There can be only one Question per Thread, and the question is the ultimate definer of the Thread.

Numbering	Network Initiative Example
Initiative Code	**NET**
Objective/Information Goal number	**NET.2** 2nd Objective in Initiative
Question number	**NET.2.3** 2nd Objective, 3rd Question

There is only one Initiative statement. Each of the Objectives within an Initiative also has a single statement

that is repeated for each of its Questions. A Thread's Question must be a single question; multiple questions are not allowed because proper measures can't be defined.

Quad Charts to F.I.R.E. Initiative Input Mapping

The diagram on the following page shows how information is transferred from the Quad Charts to the F.I.R.E. Initiative input. It is provided as a visual, quick reference for F.I.R.E. inputs. Descriptions of these planning components are in following sections. This section only shows the mapping from one to the other.

As noted above, there are two Quad Charts per Objective. In the figure, lines with balls at the end show that the Objective and Information Goal statements are a pair.

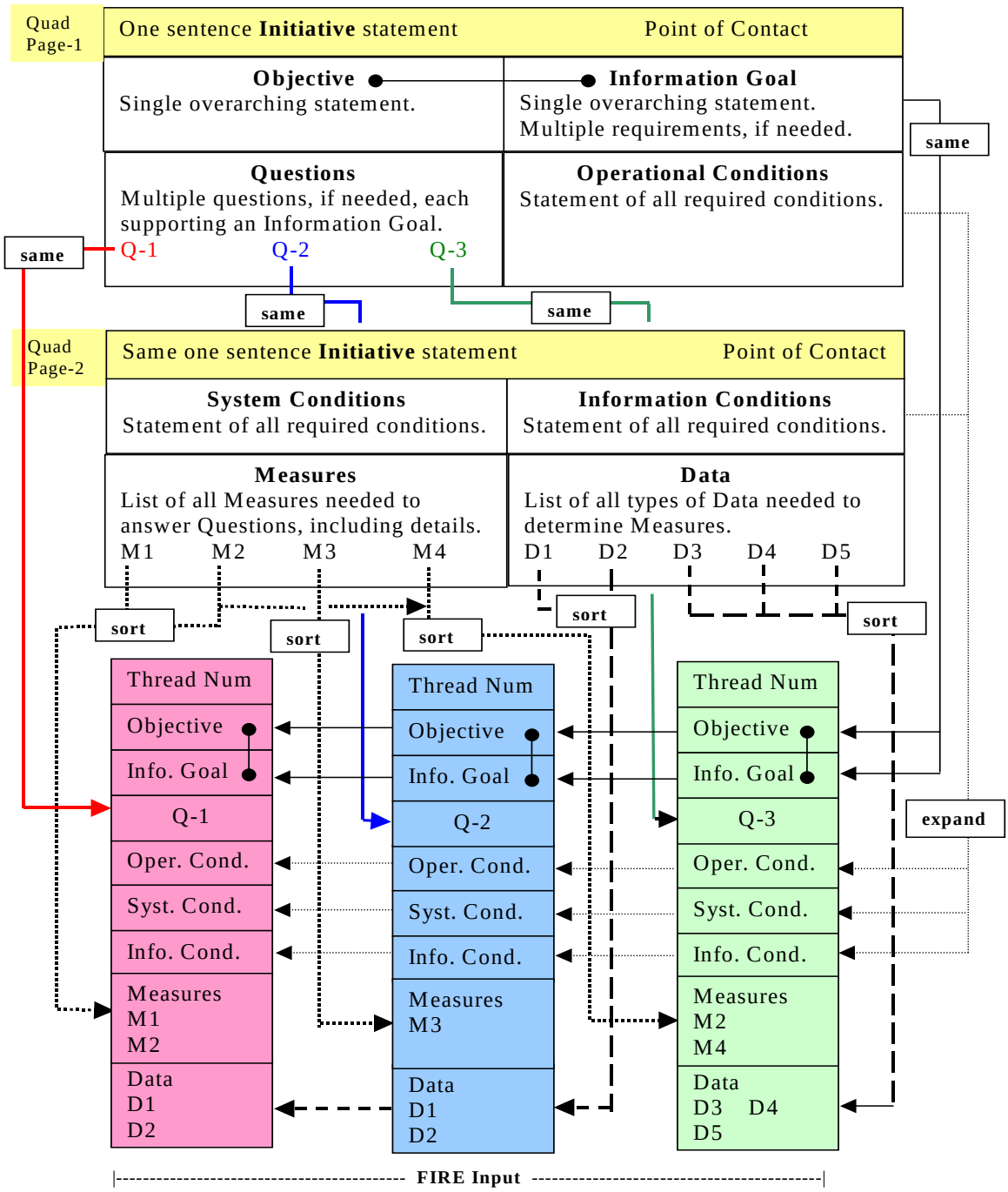
Same: indicates that the information in the Quads and FIRE are identical. This is the case for Objective and Information Goal.

Expand: the information may be exactly the same, or is essentially the same but may need some expansion to be specific for that Thread. This applies to the three Conditions.

Sort: the information in that quadrant has to be sorted to apply to its individual Thread. This applies to sorting Measures and Data so they are associated correctly with the Questions.

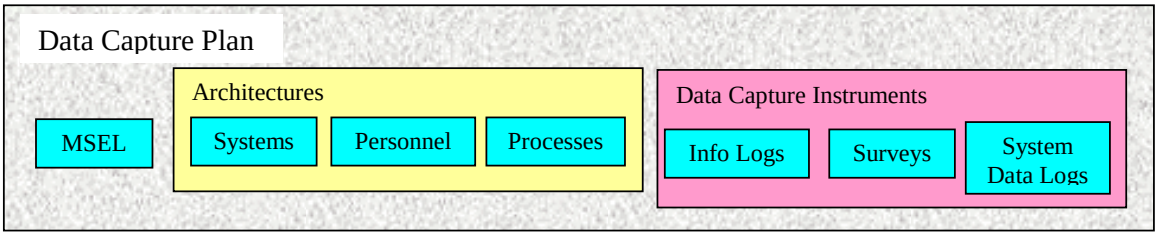
- There can be multiple Questions and each of them defines a Thread.
- There can be multiple Measures and they must be correctly associated with the Questions they will help answer. A Measure can apply to more than one Question.
- There can be multiple Data and they must be correctly associated with the Measures they will produce. More than one type of data may be needed to produce a Measure.
- The association of Question to Measures and Data can be one-to-many and association of Measures and Data

can be many-to-many. If there are too many associations, the Question is too broad. If Objectives and Questions are defined narrowly, it is possible that there will be only one Measure and type of Data for each Question.



Experiment Planning and Data Capture Plan

Experiment Planning involves working out all of the details of Data capture and publishing a Data Capture Plan that guides conducting the experiment. The following figure illustrates the components of the Data Capture Plan.



Architectures include OSDs and IDEFs. Specification of the systems to be used is done by a Systems Table and an Installs Table that tracks progress toward making the systems available.

Experiment Planning Components

Experiment Planning is grouped into categories, with components within each category. The following shows the categories and components and the type of input for FIRE required for entering them. Replicated means that that information is provided automatically from the Initiative inputs. Y/N refers to a Yes/No drop-down. Text refers to a text box where narrative input is provided.

Thread Information Thread Number Thread POC Question Measures Classified Fn Attrib/Meas	 (Replicated) (Text) (Replicated) (Replicated) (Y/N) (Text)	This is general information about the Thread. Most of it is replicated. A drop-down is used to indicate whether the information will be classified. It is at this point that the connection to FORCEnet Attributes and Measures is made.
Events Data Locations Event Times / MSEL	 (Text) (Text)	Events describe those things that are to occur when the data is being captured. MSEL (or other) events to be used are listed. The exact location(s) for data capture are listed.
Electronic Data Providing System Data Available Collection Medium Data Formats Time Stamps Avail Electronic Data POC	(Y/N) (Text) (Y/N) (Text) (Text) (Y/N) (Text)	Electronic data is that captured directly by a system being used in the operation or inserted to capture data. Feasibility check. Needed is whether or not the data will be logged, what collection medium will be used to record it, the format used, and whether synchronized time stamps will be recorded and who has direct responsibility.
Chat Logs Collection Medium Chat POC	(Y/N) (Text) (Text)	C2 and task coordination information is carried out via Chat. These logs often provide very useful data.
Observation **Logs** Logger Station Forms Completed Loggers Assigned Logging POC	(Y/N) (Text) (Y/N) (Y/N) (Text)	Personnel are used to observe operations and log events. They are placed at defined locations and use forms designed for their particular data capture.
Survey Data Surveyed Personnel Form Completed Administrators Survey Medium Survey POC	(Y/N) (Text) (Y/N) (Text) (Text) (Text)	Subjective opinions are gathered via surveys. Survey instruments that meet the Measures requirements are designed and administered to a focus group by an assigned administrator. Surveys are often completed using electronic capture.
Additional Comments	(Text)	Any comments that are needed to clarify or direct any aspect of experiment conduct.

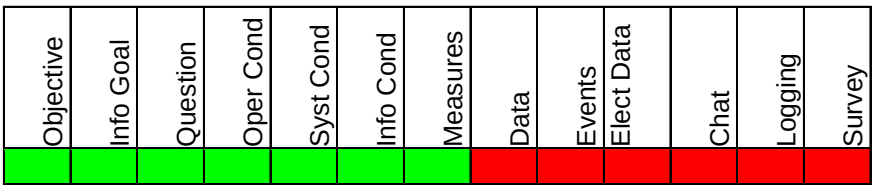
The normal situation in an experiment is that there will be data capture that applies to more than one Thread. Observers, instruments, logs, etc., can and should be shared across Initiatives and Objectives. These detailed planning components will reflect this in that the same people will appear as having responsibilities in several Threads.

FORCEnet Attributes and Measures

It is important that experiment results be mapped to official FORCEnet Attributes and Measures. It is also important the experiment measures, which will often be more detailed than the broader FORCEnet measures, be developed naturally without influence from higher-level measures. Thus, correlation between the two is not done until the Experiment Planning phase. Note in the above section that there is a place for entering this information. If there is no appropriate FORCEnet Measure, if appropriate, the Measuree(s) developed should be nominated for addition to the FORCEnet Measures.

Planning Stoplights

Red/yellow/green stoplights are provided for each Initiative. They encompass both Initiative and Experiment planning. There is a light for each of the major planning components:



The example shows all except Data of Initiative Planning green and Experiment planning red.

Stoplight colors are controlled by both the Initiative Lead and Analysis Reviewer. Initiative colors are determined by whether they meet the factors:

- Correctness of the input (meets standards for content)
- Sufficiency of the input (to enable description of succeeding components)
- Congruence between Initiative elements

Experiment planning components are judged solely on completeness. The Reviewer will send reasons for judgments to the Lead by e-mail.

Amplifying Comments on Initiative Planning Components

The following additional comments about the Planning Components are presented to better define what is required.

Examples of Planning Components will be provided under separate cover for further clarification of the information to be provided.

Objectives: Several types of Objective are appropriate:

- Develop or enhance an operational capability.
- Develop a system or test a system's capabilities.
- Develop or modify a process (normally involving human operators).
- Test TTP or SOP, or documents that direct operators.

All of these, and others, are appropriate.

The Objective statement must clearly state the exact goal, what is to be learned or accomplished.

Information Goal: An Objective and its Information Goal are a **pair**. There is only one Information Goal statement per Objective.

- There may be more than one type of information that is directly related to the Objective.

- The statement lists the types of information needed, not specifics about them. They are guidelines to the more specific Measures and Data to be obtained.

- The statement includes guidelines for the types of conditions under which the information is to be produced.

Questions: A bridge is needed between the somewhat general Information Goal statement and the specific Measures to be produced.

- A question is needed for each of the information types in the Information Goal.

- Each question defines an experiment Thread.

- Multiple Questions are not allowed, those that contain either explicitly or implied more than one question.

- A Question should be stated in a way that leads directly to the Measures to be produced.

Conditions: It is extremely important to have the proper conditions set up if appropriate results are to be produced.

- Data obtained under improper conditions will yield results that don't answer the posed question, or answer incompletely, or worse yet provide incorrect answers.

- Conditions lead directly to the MSEL.

- Specified Conditions will be needed for one or all of: Operational, System, Information.

For example: If the objective is to determine the maximum throughput that can be achieved with a particular system or process, the information load must be large enough so that the system can be stressed. This would be an Information Condition.

Measures: Answering the Question requires that specific Measures be produced. These are the quantities that will be reported as **experiment results in support of the answer to the question**.

- Each must be a specific quantity, with units if appropriate.

- There can be more than one Measure for a Question. If there are several, it may be that more than one question is needed. Reporting will be cumbersome if there are too many Measures associated with a single Question.

- A Measure must lead directly to the Data acquisition needed to determine it. This means providing some specifics that provide guidance to data capture.

    For Example: “Average processing time” is insufficient. “Average time to process BDA requests by the sensor manager” contains the needed specifics.

- If it has not been done sufficiently in Information Requirement, specify the operational unit, even the type of personnel, if they are to be involved in producing supporting Data.

- The Measure definition should imply the type of analysis to be done to reduce the data.

    When stating Measures, care must be taken to ensure that needed Data can be captured, and analyses done, that will allow them to be determined. It is not uncommon that Measures are stated that cannot be obtained within the realities of an experiment.

Data: These are somewhat general Data definitions. Specific details of where, when, and how they are captured are provided in Experiment Planning. In Initiative Planning, sufficient definition is provided to allow subsequent details to be completed.

- Data definitions specify which types of Data are to be obtained:
    - system electronic data logs
    - Chat logs, etc.
    - human data loggers
    - post- or during-experiment surveys

- These definitions alert planners to the need to produce particular Data collection instruments.

    For example: the above Measures example would lead to “Logs of

sensor requests at…". It is not necessary to specify who collects the logs or their format. This is done in Experiment Planning.

- Correlations between Measures and Data do not need to be specified. They should be obvious if the specificity referred to above has been provided.

Amplifying Comments on Experiment Planning Components

Correlations between the Data, Measures to be produced that answer the Questions, (the Threads) are contained in Initiative Planning. The focus in Experiment Planning is on obtaining the Data.

Experiment Planning specifies the physical things that must be done during the experiment, in sufficient detail, that all the needed systems, people, processes, and what they are to do, can be in place to produce the required Data.

Refer in what follows to the former section on Experiment Planning Components. The Bold words in its figure are those that appear in the stoplight and provide the subsections below.

Thread: Most of the information provided is replicated.

- Thread numbers that are entered in the Initiative input will be replicated here and an input form provided for each Thread.

- The POC information is not replicated because additional people may be involved in detailed Experiment Planning.

- The FORCEnet Attribute and Measures numbers are entered.

Events: The purpose of this information is to allow those responsible for data capture to be in place and ready to capture data at the appropriate times.

- There may be several events during the experiment that will provide the needed data.

- There may be more than one data capture location, and different types of data may be captured at different locations. Specifics are needed as to what data where.

- It may be necessary to identify a particular watch station within an organization.

- It may be necessary to identify a particular system from which data is to be obtained.

- The MSEL will be referred to for most dates and times for events. It the event is off-MSEL this should be stated along with any specifics that will help identify when the event will occur.

Data: Four types of data can be captured:

- Electronic
- Chat
- Observation Logs
- Surveys

The section for each data type is headed by a Y/N dropdown. This is to indicate whether that type of data is required. If the answer is no, there is no need to provide any further input for that data type.

The Experiment Planning input forms in F.I.R.E are set up so that there is no background color if no input is provided for an element. Thus, for a data type not required that whole section will be white (except for the Y/N answer).

Electronic Data: These data are captured directly by a system being used during the experiment.

- Each system that will provide such data must be identified. The specific data within the system to be captured must also be identified.

- It is often the case that no automated logs are either available or turned on for this data capture. This must be determined and the Y/N is provided for status.

- It is important to know the medium used for data capture. The medium must be compatible with subsequent data reduction capabilities.

- Understanding data formats is important for subsequent data reduction. The format should be specified and determination made as to whether it is compatible with reduction methods.

- It is normally assumed that systems have time stamps available for all data output, but this often the case. This must be checked. Timing is crucial for many Measures. It must also be determined whether or not time synchronization procedures have been established.

Chat Logs: Communications that are carried out via Chat can provide either direct or supporting data.

- It must be insured Chat will be logged by the system being used, that personnel are assigned to capture Chat logs, and that appropriate recording media will be in place.

- Insure that there is a means to synchronize Chat log times with other time logs and that logs will have time stamps.

Observation Logs: Observations are logged by an observer assigned to a specific location.

- The specific station to be monitored must be stated.

- Logging forms will be specific to the information to be obtained at each location. Stated should be the specific information to be obtained and what measures this information will be used to produce.

- Logs must contain the time at which a “happening” is observed.

Survey Data: Surveys are the principal means for obtaining subjective information about a process or system. This information is primarily opinions.

- Specific personnel to be surveyed must be described.

- Surveys will be specific to the information to be obtained. Stated should be the specific information to be obtained and what measures this information will be used to produce.

- Surveys can be administered by paper or electronically. The means for administering and for post-completion archival should be stated.

Required Documents: Most detailed planning information appears in other documents, MSEL, Systems, etc., not in the Experiment Planning forms. These other documents are used as references during experiment planning. Conversely, experiment planning also produces these documents. They are a crucial part of planning and it is not be possible to complete planning until they are complete. The way the planning forms are set up, it will not be possible to complete them until these required documents are also completed.

APPENDIX B. EXPERIMENTATION CHECKLIST

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January 7, 2004
VER. 4.0

January 7, 2004
Experimentation Management Guide

Purpose: This task list provides a decision support and management tool for experimentation sponsors, executive agents or action officers, and task managers. It is intended to support planning, preparation, and execution of experimentation within the context of an experimentation campaign. It is intended primarily as a guide to support individuals and teams to identify the analytical activities (the what's) needed to develop the experimentation framework, and a set of process mechanics (the how's) to achieve desired outcomes. It is also intended to assist senior decision makers in addressing tradeoffs associated with an experimentation campaign over extended time horizons, involving complex environments, multiple stakeholders,[1] competing research interests, and limited resources.

Background: This task list complements the *Code of Best Practice for Experimentation* (*COBPE*)[2] developed by the Command and Control Research Program (CCRP) of the Assistant Secretary of Defense for C3I. The *COBPE* provides an overarching approach to the conceptualization, design, and execution of individual experiments or experimentation campaigns, and was developed to investigate evolving operational concepts and other areas of interest. The *COBPE* recognizes that, as a practical matter, the dynamics of experimentation are influenced by many factors beyond the

[1] A stakeholder is anyone who has specific interest in the results of the experimentation campaign. A sponsor is a stakeholder with specifically defined roles in providing resources to conduct the experimentation campaign.

[2] *Code of Best Practice for Experimentation*, David S. Alberts, Richard E. Hayes (Washington, D.C.: CCRP, 2002).

control of the experimenters, especially in large events with long planning and preparation lead times.

The work reported here was based on the Multi-INT Experimental Checklist developed by a team led by Annette Krygiel. That effort had developed an intelligence-related checklist based on the COBPE. The present work represents an effort to extend the Multi-INT Checklist to apply to defense-related experimentation efforts in general.

Format: This task list provides the elements of an iterative cycle (as shown in Figure 1) combining development and assessment activities leading to the conduct of experimentation events. Critical to the success and relevance of each experiment or event is for the process to adapt to changes in priorities, environment, and stakeholder interests over the course of event preparation. There are two elements to the experiment: planning and execution. The planning process includes three critical components:

1. Establishing an Experimentation Framework
2. Planning and Design
3. Development and Validation

Execution also includes three components:

4. Preparation and Rehearsal
5. Execution
6. Analyses, Evaluation, and Transition

It is important to note that many of the experiment development and execution activities are cyclical and overlapping rather than sequential. Figure 1 provides one way to visualize this process. The process must be flexible enough to revisit components as needed. It should also be noted that as environmental conditions change and stakeholder interests are affected, options should be established for continued participation or the entry of new participants. The checklist is directed mainly at individual experiments, but the planning process described in Section 1 applies equally well to the planning of an experimentation campaign.

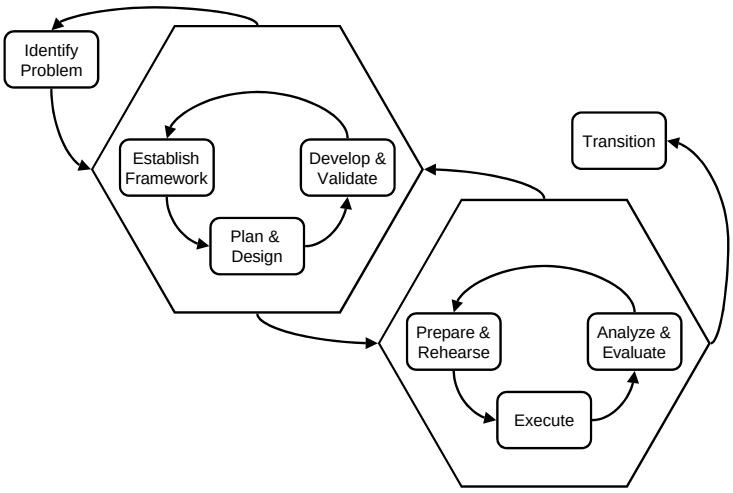

Figure 1. “The Iterative Cycle for Experimentation”

1. Establishing an Experimentation Framework

1.1 Articulate and establish research/investigative objectives.

1.1.1 Generate an agreed upon and commonly understood statement of problem(s) to be investigated.

1.1.2 Ensure empowered representation from the constituents of the defined community.

1.1.3 Ensure the objectives of the investigation or experiment are measurable, and are clearly, simply, and soundly stated.

[These steps may be accomplished in a workshop or planning conference.]

1.2 Analyze alternatives.

1.2.1 Determine and consider alternative investigative methods to experimentation in terms of products, cost/benefit, feasibility, and risk.

1.2.2 Determine viable approaches to investigate areas of interest, i.e., discrete events and linkages with other experiments or research activities.

[Careful articulation of information needs can facilitate obtaining data from other research activities or confirming that a gap exists.]

1.2.3 Determine requirements for repeatability, validity, and credibility.

1.2.4 Decide to conduct the experiment(s) including identification of needed resources and resource providers.

1.3 Identify the community of interest.

1.3.1 Identify stakeholders and potential sponsors as well as their expectations and concerns.
1.3.2 Identify “senior leadership” for the event, i.e., the decisionmaker for abort criteria.
[It is particularly important for senior leadership to be kept informed of the range of expectations and agendas represented by the various stakeholders.]
1.3.3 Define the “total” environment – research, operational, political, technical.
1.3.4 Determine range of possible effects of investigation at technical, operational, programmatic, cultural, and other levels (e.g., development of new knowledge, changed organizational structures, programmatic resources).
1.3.5 Develop a program of peer reviews, involving independent evaluations by knowledgeable personnel of the technical, programmatic, and operational merits of particular aspects of the experiment or the campaign.
1.3.6 Identify peer reviewers and enlist their participation.

1.4 Identify interests of stakeholders.

1.4.1 Identify points of common interest and points where interests do not converge, in order to define a deconfliction process.
[The experimentation campaign planners must accommodate the concerns of those who will be affected by the experimentation process and its results.]
1.4.2 Define the level(s) of interest for process results—national, local, service, joint, limited objective, campaign.
1.4.3 Define, with senior leadership, the purpose and desired product types for the process, to avoid excessive focus on the output of only one event or experiment.
1.4.4 Establish strategic, campaign level focus linking multiple events. Emphasize cumulative development of a body of knowledge that does not depend on the results of only one experiment or research activity.

1.5 Engineer flexibility into the process.

1.5.1 Define critical decisions (rather than milestones) to allow for confirmation of sponsor and

stakeholder interests, commitment to the course of action, and opportunities for the graceful exit of stakeholders who no longer wish to be part of the event as well as entry of new stakeholders.

1.5.2 Determine constraints on the experiment or on the campaign that impact iteration/refinement cycles (see Figure 1).

[Reviews should be provided to senior leadership to ensure that the ramifications of decisions and directions are recognized.]

1.6 Scope the effort.

1.6.1 Obtain general agreement on the type of experiment(s) to be conducted e.g., discovery, hypothesis testing, and demonstration,.

[In principle, it may be advisable to change the experiment type during the development process. This is a major decision requiring careful assessment and stakeholder participation.]

1.6.2 Derive the simplest experimentation approach – lab test, modeling and simulation, limited field test, etc. – to deliver desired results.

1.6.3 Document the responsibilities of each participant and obtain a common understanding and agreement among the participants.

1.6.4 Identify and execute any required contractual vehicles.

1.6.5 Determine, plan, and program to ensure availability of required prototypes, systems, materiel, databases, and infrastructure.

1.6.6 State desired outcomes, being explicit in terms of goals, metrics, applications, and relevance to type of experiment.

1.7 Establish strategic framework.

1.7.1 Identify, assess the relevance of, and pursue cooperative joint efforts with complementary research programs including those in military services/joint environments, government agencies, academe, research and development organizations, and other venues.

1.7.2 Develop contingency planning options and procedures in anticipation of unexpected events and disruptions.

1.7.3 In the case of incremental funding, ensure resource commitment and scheduling.

1.7.4 Establish tracking and management mechanisms, e.g., funding expenditures and calibrate against projected costs for the experiment, development of needed infrastructure and capabilities, task execution.
1.7.5 Develop an experiment schedule to address all phases and resource requirements.
1.7.6 Assess and account for potential impact of experimentation environment on experimentation process and outcomes.
1.7.7 Initiate actions to secure required funding, resources, and approvals.

1.8 Identify requirements.

1.8.1 Determine minimum resources (personnel, facilities, time) to execute the experiment.
1.8.2 Identify unique requirements for experiment conduct and design (infrastructure) to include:
- Data collection team qualifications/assignments.
- Data collection team training.
- Instrument development.
- Consistency of involvement in experiment preparation period.
- Selection of experimentation infrastructure (live/modeling and simulation supported).
- Identification of all factions to be represented, e.g., Blue/Friendly, Red/Hostile, White/Neutral, Green/Third Party, etc.

1.8.3 Identify unique requirements for experiment participant (subject) selection and preparation to include desired expertise, training requirements, preparation timelines, language proficiency, experience sets, and Service or Combatant Command representation.
1.8.4 Determine required approvals to conduct experiments, e.g., review board approvals for use of human participants in experimentation.
1.8.5 Schedule a policy review early to identify security issues, such as need for accreditation, or policy waivers.
1.8.6 Determine requirements for, and initiate processes to obtain, waivers, such as that of security policy.

1.9 Commit resources.

1.9.1 Gain commitment of research sponsor(s) and degree of support through written agreement with participating agencies, i.e., ensure proper staff availability and secure needed resources and/or funding.

1.9.2 Assign and ensure commitment of Experiment Director/Action Officer through the research sponsor.

1.9.3 Document requirements in experiment objectives, requirements, and expected outcomes with research sponsor.

1.9.4 Ensure early identification and commitment of all experiment participants by their respective organizations – customers, process-owners, subject matter experts, prototype developers, facilities-owners, trainers, security personnel, etc.

1.9.5 Document facility requirements and obtain agreements for their provision with hosts and supporting organizations to ensure scheduling and availability.

2. Planning and Design

2.1 Define role of the particular experiment within the campaign

2.1.1 Assess current state of knowledge in terms of what the campaign has answered so far and identify remaining unresolved issues

2.1.2 Inform senior leadership and confirm research priorities.

2.1.3 Define and decide the next step in experimentation or investigation.

2.2 Formulate experiment.

2.2.1 Review results of research relevant to the intended experiment, including reviews of studies, experiments, customer and process-owner input, etc.

2.2.2 Identify the products and implications of the experiment, such as residual assets, evaluation, requirements for acquisition, new business processes, etc.

2.2.3 Ensure that the experiment incorporates appropriately mature elements, such as existing prototype versions, surrogates or mock-ups, and modeling and simulation.

2.2.4 Submit the experiment plan for peer reviews or independent assessments.

2.2.5 Develop hypotheses (IF, THEN statements) that are generated and structured to contribute to knowledge about the concept, capability, system, or process being investigated.

2.2.6 Assess prototypes, cost, risk, and schedule acceptability constraints (for experimentation).

2.3 Plan the analysis and evaluation methodology.

2.3.1 Identify control variables and determine means to treat them adequately.

[All variables should be identified by type (independent, dependent and control). Both manipulation and control are integral to hypothesis-testing experiments. The dependent variables are observed systematically under specified conditions while the factors considered to cause change – the independent variables – are varied. Other potentially relevant factors must be held constant, either empirically or through statistical manipulation. (Extracted from Code of Best Practices for Experimentation by Dr. David S. Alberts.)]

2.3.2 Determine whether a documented baseline for comparison exists or the means to generate one in time for the conduct of the experiment.

2.3.3 Ensure that the evaluation method selected is relevant to the type of experiment, select appropriate metrics, and determine options to populate them through data collection.

2.3.4 Ensure participants for experiment have desired expertise, training requirements, preparation timelines, language proficiency, experience sets, and Service or Combatant Command representation.

2.3.5 Ensure processes and organizational changes are considered in the evaluation.

2.3.6 Ensure that the plans for scenario generation are sufficiently timely and that they span the conditions of interest to the sponsors.

2.3.7 Develop Analysis Plan, framework, and reporting requirements.

2.3.8 Develop data collection plan(s) for processes during the experiment and/or across the range of experiments within the campaign to ensure sufficient data to support the evaluation. Consider means to ensure that:

· Data collected reflect critical indicators.
· Quality control processes are included

- Data collection allows for re-use and archiving through file collection and indexing
- Standard data formats are used where possible, including date/time references.
- The evaluation plan addresses how to interpret, generalize, or scale the results of the experiment.

2.3.9 If modeling and simulation will be used to validate and expand experiment findings, then ensure that appropriate models and simulation capabilities are available, or planned.

2.4 Plan experiment and develop experimental architecture.

2.4.1 Determine and ensure understanding of applicable technical standards that must be developed and/or applied where feasible.

2.4.2 Determine if existing experimentation infrastructure in other experimentation and research venues such as Joint Forces Command (JFCOM), service laboratories, and academic institutions can be used/leveraged.

2.4.3 Identify and describe any legacy system enhancements or needed infrastructure/tool development.

2.4.4 Identify, schedule, and ensure commitment by their owners and/or sponsors of required prototypes, systems, materiel, databases, and infrastructure, including all Government Furnished Equipment (GFE) and Government Furnished Information (GFI) by specific dates.

2.4.5 Ensure appropriate means of technical control over infrastructure development, such as configuration management processes.

2.4.6 Ensure engineering resources are available as needed to develop the end-to-end architecture to support the experiment.

2.4.7 Map appropriate elements of operational concept or problem being investigated to scenario. State research questions and framework for reporting results per the analysis plan.

2.5 Conduct facility planning.

2.5.1 Determine and schedule facilities and resources required for experiment in terms of manpower, equipment, infrastructure, etc. in accordance with the

needs of each specific phase of the experiment and by specific dates.

2.5.2 Identify and resolve potential conflicts with other events supported by the experimentation facility such as training, integration and test, rehearsal, and experiment conduct.

2.5.3 Assess facility layout and determine means to minimize or avoid distractions and disruptions, such as from visitors and observers.

2.6 Develop training.

2.6.1 Determine training criteria and required standards of proficiency.

2.6.2 Plan and program training for experiment support personnel including observers, roleplayers, data collectors, M&S support, collection managers and others.

2.6.3 Plan and program training for experiment participants to ensure familiarity (as appropriate) with operational concepts, experiment infrastructure, experiment information exchange processes, and roles of other participants.

2.7 Conduct security planning.

2.7.1 Identify security issues and/or engineering requirements using appropriate instructions, e.g., Defense Information Technology Security Certification and Accrediation Process (DITSCAP) or National Information Assurance Certification and Accreditation Process (NIACAP).

2.7.2 Assess impact of security requirements or experiment and data availability, e.g., access by foreign nationals, “uncleared” researchers, storage of data and documents, system connectivity.

2.7.3 If needed, secure and schedule needed security resources, e.g., storage containers, destruction resources, access control resources, storage devices, etc.

2.8 Determine risk and define risk management procedures.

2.8.1 Identify types and levels of risk to experiment success, infrastructure, personnel availability, funding, schedule, and cost

2.8.2 Determine requirements and options to mitigate risk.
2.8.3 Develop risk mitigation plans for high-risk elements such as immature infrastructure components, use of surrogates, variance in software/hardware versions, long lead items, and generation of essential databases.
2.8.4 Establish guidance on documentation requirements of any design and development.

2.9 Conduct schedule planning and control.

2.9.1 Ensure that the proposed schedule is viable given the scope of the experiment, the identified risks, and the proposed funding.
2.9.2 Identify critical event dependencies and long-lead items for key activities.
2.9.3 Schedule:
- Adequate time for development and conduct of training for observers, support staff, as well as participants.
- Progress reviews for assessments of risk and progress for experiment participants, through all phases of the experiment.
- Progress reviews, peer reviews, and critical decision reviews for programmatic goals, including one at the completion of planning phase.
- Sufficient time for testing and integration of the hardware/software/infrastructure.

2.10 Conduct transition planning.

2.10.1 Develop a transition plan to pass findings and conclusions to stakeholders.
2.10.2 Implement a communications strategy to disseminate information to participating and interested parties, e.g., form/type of briefings, web posting, email distribution lists, etc.
2.10.3 Identify budget or Program Objective Memorandum (POM) submissions potentially affected by the experiment.
2.10.4 Identify and schedule a knowledge repository—e.g., an archive or website—for experimental results.
2.10.5 Ensure agreement and funding support for any residual assets either left in place or transitioned to the appropriate sponsors.
2.10.6 Estimate funding requirements for follow-on research and development activities, e.g., refinement

of prototype, additional experiments, acquisitions, etc.

3. Development and Validation

3.1 Complete design and implementation plan.

3.1.1 Schedule or complete final experiment design.
3.1.2 Ensure final experiment architecture and implementation are on track.
3.1.3 Ensure development of the data collection plan is on schedule or complete, including quality control processes.
3.1.4 Ensure test and integration is proceeding on schedule, or completed.
3.1.5 Schedule and/or complete development and testing of infrastructure, support tools, required databases.
3.1.6 Ensure experiment analysis and evaluation plan are complete and all activities are on track.
3.1.7 Establish and determine application of measures of effectiveness, metrics, and/or success criteria and incorporate in the analysis and evaluation plan.
3.1.8 For experiment/research campaigns, establish iterations and entry/exit criteria.
3.1.9 If required, prepare help desk for the experiment.
3.1.10 Ensure security policies reviews are completed, accreditations obtained, or formal waivers obtained.
3.1.11 Ensure that development and implementation of operational scenarios, concepts, and script are complete or proceeding on schedule, including
- Models and simulations.
- Training.
- Orientation and familiarization plans and materials for participants.

3.2 Execute readiness review.

3.2.1 Schedule review of experiment preparations for the research sponsor(s).
3.2.2 Identify a means to address problems and issues, and ensure availability of resources for corrective actions.
- Ensure data collection instruments and participant forms/questionnaires are available.
- Schedule observer interviews.

- Schedule appropriate mechanisms to capture and disseminate information such as recording of briefings.

3.2.3 Implement help desk.

3.2.4 Establish visitor access and control procedures.

3.2.5 Ensure data collection team and resources are ready, including a means to archive all collected data.

3.2.6 Implement process to capture Lessons Learned.

3.2.7 Implement control processes for changes to experiment environment, infrastructure, and procedures that may be caused by anomalous interruptions.

3.2.8 Describe and document rehearsal procedures for all participants and assign all responsibilities.

3.2.9 Ensure sufficient time is included in the schedule to take corrective action as needed after the rehearsal.

3.2.10 Ensure all activities in the conduct of the experiment are addressed and documented, including those of participants, observers, and visitors, in addition to equipment, systems, and infrastructure.

4. Preparation and Rehearsal

4.1 Conduct rehearsal.

4.1.1 Include participants, observers, support personnel, and (acting) visitors engaged in the rehearsal.

4.1.2 Exercise the supporting infrastructure, including instrumentation.

4.1.3 Exercise all key activities and processes in the experiment design and plan– including data collection and analysis.

4.1.4 Ensure rehearsal includes practice vignettes and end-to-end scenarios.

4.1.5 Stress the system architecture to ensure all experiment requirements are supported.

4.1.6 Ensure a process exists to capture anomalies and unexpected disruptions and to take corrective actions in the experiment.

4.1.7 Verify that the experiment addresses the original objectives.

5. Execution

5.1 Collect data.

5.1.1 Collect, verify, and archive data including observer notes and informal interviews.
5.1.2 Monitor quality control mechanisms for data collection.

5.2 Ensure daily communications plan is followed.

5.2.1 Schedule roundtable information exchange meetings of the data collection team and other observer groups.
5.2.2 Archive notes, data collection instruments, and other materials such as emails, voice communications logs generated during experimentation events.

5.3 Document experiment process and lessons learned.

5.3.1 Document changes (functionality) or deviations from experimentation plan in accordance with technical control plan.
5.3.2 Record down time and perceived impact on experiment in light of system or process failures such as power outages, interruptions, and loss of participants in logs and data compilation.
5.3.3 Capture and document lessons learned in experiment process.
5.3.4 Provide “hot wash” briefing and discussion for participants and capture resulting comments and observations.

6. Analyses, Evaluation, and Transition

6.1 Provide a “quick look” report and briefing for stakeholders.

6.1.1 Report, at a minimum, the assumptions and major findings of the experiment and any initial recommendations affecting the experiment campaign or related operations.
6.1.2 Identify any unresolved issues, uncertainties, and sensitivities discovered in the experiment.
6.1.3 Provide for the widest possible circulation of the briefing and report and invite review and critique.
6.1.4 Caveat “quick reaction” results to avoid premature conclusions and recommendations.

6.2 Prepare and distribute a report of preliminary findings within a reasonably short time after the experiment.

6.2.1 Distinguish clearly between findings (factual observations and data) and interpretations of the results.
6.2.2 Describe the effects of interruptions, disruptions, anomalies, etc.
6.2.3 Collect peer review results and incorporate them into revised and future reports.

6.3 Prepare and publish formal reports.

6.3.1 Adopt and implement a publication and dissemination plan to provide a range of products (decision papers, summary reports, briefings, scientific papers, articles, and books) suited to the needs of various audiences and stakeholders.
6.3.2 If appropriate, provide a synthesis of findings and interpretations from across several related experiments, especially those in the experimentation campaign that includes the present experiment.
6.3.3 Provide recommendations for iterations of the experiment or practical application of results in exercises, as well as future experiments based on issues uncovered or knowledge derived.
6.3.4 Provide lessons learned about the experimentation processes, tools used, and infrastructure. Incorporate considerations for scaling or expanding results by further experimentation, modeling and simulation, or other means.
6.3.5 Identify and address programming and budgeting implications, including resources needed to transition results, e.g., refinement of prototypes, more experiments, implications for on-going acquisitions. Identify any budget or POM submissions affected.

6.4 Archive experiment design, data, and results for future use.

6.4.1 Collect all data records, interview transcripts, scenario descriptions, training manuals, and other artifacts immediately after execution of the experiment and preserve them in their original form.

6.4.2 Compile and archive a dictionary/glossary of the terms, constructs, and acronyms used in the experiment.

6.4.3 Compile and archive a dictionary of methodology and metrics (including definitions and scales) used in the experiment.

APPENDIX C. COMFLTFORCOM INSTRUCTION 3900.1A

DEPARTMENT OF THE NAVY
COMMANDER
U.S. FLEET FORCES COMMAND
1562 MITSCHER AVENUE SUITE 250
NORFOLK, VA. 23551-2487

CFFCINST 3900.1A
N8
22 Dec 03

COMFLTFORCOM INSTRUCTION 3900.1A

Subj: SEA TRIAL

Ref: (a) Naval Power 21
(b) CNO 011515Z Oct 01 (Sea Power 21 Implementation)

Encl: (1) Sea Trial process diagram

1. Purpose. To provide Commander, U.S. Fleet Forces Command (CFFC) policy guidance, establish responsibilities, and prescribe general procedures for establishing and executing Sea Trial in support of Sea Power 21.

2. Cancellation: COMFLTFORCOMINST 3900.1

3. Background. Naval Power 21, reference (a), provides SECNAV's vision for Navy and Marine forces. CNO and CMC have established Sea Power 21 and Marine Corps 21 as the Navy and Marine Corps' strategy for the 21st Century. Sea Power 21 is built around the core concepts of Sea Strike, Sea Shield, Sea Basing, enabled by FORCEnet, with US Marine Corps Expeditionary Maneuver Warfare (EMW) and Joint maneuver warfare from the Sea Base fully embedded. Sea Trial will integrate emergent concepts and technologies into an experimentation process that will produce continuous improvements in naval warfighting. Reference (b) established CFFC as the lead agent for Sea Trial.

4. Objectives. Through Sea Trial, Fleet Forces Command (FFC) will formalize and fully integrate concept development and technology insertion into the experimentation process. Sea Trial will be Naval in focus through close coordination with the Marine Corps Combat/Force Development Process, and will support concurrent development and testing of joint warfare capabilities from the Sea Base. A comprehensive Sea Trial Concept Development and Experimentation (CD&E) Plan will rapidly mature Sea Shield, Sea Strike, Sea Basing and FORCEnet concepts and technologies, codify experiment results in doctrine, and reflect in programs of record. The CD&E Plan will be concept-based and aligned to mission capabilities gaps and Fleet priorities. Emphasis will be on:

a. Speed -- Expeditious induction of new concepts and technologies into the experimentation process, along with rapid transition of promising outcomes into doctrine and program.

b. Comprehensive -- Single point visibility over all Navy experimentation other than the Discovery and Invention portion of the Navy's Science and Technology effort.

c. Jointness -- Maximum incorporation of Joint Concept Development and Experimentation (JCD&E) into Navy processes.

d. Relevance -- Applicability of experimentation to mission capability gaps in naval warfighting.

e. Economy -- Maximum effectiveness and efficiency from Concept Development and Experimentation (CD&E) efforts.

5. Joint Applicability. Marine Corps operating forces are part of the fleet. Accordingly, the Marine Corps will be an equal partner at each level within the Sea Trial process and will use the Sea Trial process to coordinate their (CD&E) efforts that are inherently naval and not service specific. As the Deputy Commandant for Combat Development, Commanding General Marine Corps Combat Development Command (CG MCCDC) is the Marine Corps' Sea Trial coordinator. Sea based operations will be increasingly important to overall joint/combined warfare missions. To that end, coordinated efforts with the Army, the Air Force and other forces are important to maximize the payoff of ongoing naval force experimentation to future joint/combined war fighting effectiveness. Concurrently, and to the greatest extent possible, Sea Trial will also support future coalition operations. Finally, Joint Forces Command (JFCOM) plays a key role in JCD&E, and a strong relationship will exist between Sea Trial efforts and JFCOM interests.

6. Sea Trial Organization. Sea Trial is a CFFC-led collaborative effort that includes COMPACFLT, COMNAVEUR, DCNO (N6/N7), CNR, CNWDC, CG MCCDC (DC, CD), C3F, C2F, C5F, C6F, C7F, NETWARCOM and others involved in Naval CD&E

a. Sea Trial Executive Steering Group (STESG). CFFC will establish and chair a flag officer Sea Trial Executive Steering Group (STESG) comprised of COMPACFLT, COMUSNAVEUR, DCNO (N6/N7), CNR, CNWDC and CG MCCDC (DC, CD). COMSECONDFLT, partnered with COMFIFTHFLT and COMSIXTHFLT, and COMTHIRDFLT, partnered with COMSEVENTHFLT, will participate as Sea Trial Operational Agents

for Sea Strike, Sea Basing and Sea Shield. COMNAVNETWARCOM will participate as the Sea Trial Operational Agent for FORCEnet. Marine Corps operational forces (MARFORLANT and MARFORPAC) designated by CG MCCDC (DC,CD) will participate as counterparts to the Operational Agents to address Naval issues as appropriate. A single Flag-level representative of each SYSCOM will participate in STESG meetings as advisory members for matters relating to Research and Development (R&D) and industrial base capability. A COMOPTEVFOR flag level representative will participate in STESG meetings and advise on Operational Test and Evaluation (OT&E) matters. The STESG will coordinate an agile, responsive and transformational Sea Trial process. Members and designated commands will coordinate quarterly to validate recently completed military utility assessments, determine if additional testing is required and/or recommend follow-on action including analysis and programming via the Naval Capabilities Development Process and PPBE, approve the Sea Trial Execution Plan including any modifications, additions or deletions of follow-on events based on the results of other completed testing, resolve issues of resources and/or priorities, assess non-traditional solutions to ongoing warfighting development issues, and make recommendations to CFFC on the viability of emergent concepts and technologies. Events approved by the Operational Agent but remaining unscheduled will be reviewed at each STESG. This dynamic review process will ensure Sea Trial remains agile and responsive to emerging concepts or materiel solutions to warfighting challenges.

b. Operational Agents (OA). COMSECONDFLT (partnered with COMFIFTHFLT and COMSIXTHFLT) is the Sea Trial Operational Agent for Sea Strike and Sea Basing. COMTHIRDFLT (partnered with COMSEVENTHFLT) is the Sea Trial Operational Agent for Sea Shield. COMNAVNETWARCOM is the Sea Trial Operational Agent for FORCEnet. Operational Agents are responsible for overall prioritization and coordination of all aspects of warfighting CD&E within their respective pillar areas. The Operational Agents, supported by members of the Fleet Collaborative Teams (FCT) and NWDC, will validate proposed CD&E initiatives (contained in the Sea Trial Information Management System (STIMS)); oversee the planning, coordination and conduct of Sea Trial events; and brief results to the STESG. Any activities desiring to conduct a Sea Trial event that falls in part or wholly under one or more of these pillars will fully coordinate such initiatives through the respective OA, and will ensure these initiatives are entered into the STIMS database. Marine Corps operational forces (MARFORLANT AND MARFORPAC) designated

by CG MCCDC (DC,CD) will participate as counterparts to the Operational Agents to address Naval issues as appropriate.

c. Fleet Collaborative Teams (FCTs). These teams are chartered by CFFC and will contribute to the Naval Capability Development Process (NCDP) and CD&E efforts. FCTs will leverage the intellectual capital of Warfare Centers of Excellence (WCOE), NWDC, ONR, TYCOMs, SYSCOMs, Fleets and other commands, and are generally organized along Mission Capability Package (MCP) lines under the Naval Capability Pillars (NCP) of Sea Strike, Sea Shield, Sea Basing and FORCEnet. FCTs will provide the Operational Agents with the necessary expertise to develop and evolve the Sea Power 21 operating concepts. WCOEs are key to the CD&E aspect of the FCT's charter, as they will be responsible for key elements of doctrine, tactics, techniques and procedures (TTP), Lessons Learned Remedial Action, and CD&E. This directive authorizes Operational Agents, acting on behalf of CFFC, to direct FCTs in their MCP areas for development and implementation of experimentation plans. In addition to their role in the NCDP process, FCTs will contribute to CD&E in the following manner:

(1) Develop Sea Power 21 Operating Concepts. The FCTs are responsible to their respective Operational Agents for development and evolution of Sea Power 21 operating concepts and the overall direction for CD&E in their respective areas. NWDC will coordinate this effort across all OA Sea Trial activities, and FFC N8 will assist in this process.

(2) Provide Subject Matter Experts (SMEs) for, and participate in, concept development initiatives germane to their mission area to include wargaming (including modeling and simulation), MCP Integrated Product Teams (IPT), Sea Trial Military Utility Assessment (MUA) teams, limited objective experiments (LOEs), employment of operational prototypes and major field experiments (e.g. Fleet Battle Experiments (FBEs), and USMC Advanced Warfighting Experiments (AWEs)). Operational Agents will periodically convene concept development workshops that combine the efforts of SMEs, operators, technologists, and network specialists to formulate innovative new operating concepts that harness advanced systems to provide enhanced capabilities in their assigned mission areas.

(3) In cooperation with and with the approval of the OA(s), develop Sea Trial Execution Plans that support the Sea Trial CD&E Plan. FCTs will develop Execution plans for their

mission/functional area for approval by the Operational Agent in coordination with CFFC (NWDC facilitating).

(4) Ensure Sea Trial Events are properly planned and scheduled. The FCT, assisted by NWDC, will identify requirements necessary for Fleet schedulers/planners.

(5) Review and Process Military Utility Assessments.

(6) Participate in TACMEMO development and support experimentation and Tactics, Techniques and Procedures (TTP) for validated capabilities.

(7) Oversee and report to their respective Operational Agents on the implementation of the approved and funded CD&E activities laid out in the Sea Trial Execution Plan.

7. Sea Trial Process.

a. CD&E initiatives, whether concept or technology based, will be submitted by the FCTs, OPNAV, ONR, SYSCOMS, Industry or other agencies to NWDC for consolidation, tracking, and coordination via the STIMS database. Demonstrations, events, experiments, or prototypes designed to explore new technologies or concepts with the fleet, or on behalf of the fleet, require strict adherence to the Sea Trial process. This includes entering information into STIMS. NWDC will ensure distribution to all activities.

b. The OA, assisted by NWDC and FCTs, will examine CD&E initiatives to determine their technical feasibility, relevance to the Sea Trial CD&E Plan, whether the initiative meets Fleet priorities (as determined by OAs) and/or Mission Capability gaps, and identify the appropriate experimental venue. Initiatives failing to meet the criteria will be rejected by the Operational Agent and the sponsor and CFFC will be informed of the rationale.

c. The Operational Agent will examine validated initiatives to determine if additional monetary resources are required.

(1) Validated initiatives that are adequately resourced will continue to be processed as follows. The event's sponsor, in coordination with the FCTs and NWDC, will develop an experimentation plan and submit it to the OA for approval. This plan will describe how the experiment will be conducted and will include a data collection and analysis plan (DCAP) with appropriate metrics. Once approved, these validated initiatives

will become Sea Trial events and the OA will provide an information brief to the STESG at the first opportunity. CFFC (with NWDC as agent) will then assign the Military Utility Assessment (MUA) team and MUA timeline.

(2) Initiatives with resource issues will be forwarded to NWDC for broad effort resolution, or (if beyond existing resource capability) for presentation by NWDC to the next STESG for resolution (i.e. funding, postponement, modification, or termination). In those instances where an important Sea Trial opportunity will be missed by waiting for the next full STESG meeting, NWDC will prepare and immediately electronically forward to all STESG principals a summary of the proposed event and actions required to support a coordinated decision, ensuring the responsiveness of the overall system.

d. NWDC will align all events across all Naval Capability Pillars and present a consolidated Execution Plan to the STESG. The Execution Plan will be presented to the STESG in June and will outline the CD&E intentions for the subsequent two fiscal years. Changes to the Execution Plan will be briefed to the STESG by the OA proposing the change.

e. The OA will publish a Quick Look upon completion of the Sea Trial event and provide it to the STESG.

f. The MUA team will complete the MUA in accordance with the MUA timeline and submit it to the OA for approval. Completed MUAs will be distributed and briefed to the STESG by the respective OA. NWDC will coordinate these briefings for the STESG, with the goal of providing an efficient summary of Sea Trial products completed since the previous STESG meeting, and as a basis for review of planned and pending Sea Trial events in support of dynamic validation of the overall Sea Trial CD&E Plan. MUA recommendations will be categorized into Doctrine, Organization, Training, Materiel, Leadership, Personnel and Facilities format. The STESG will rate each recommendation based on four possible outcomes. OPNAV N6/N7 is the single point of entry for FFC products (with the exception of doctrine) resulting from Sea Trial experiments. Events classified as having significant enhanced warfighting capability impact will be presented to CFFC for immediate delivery to OPNAV N6/N7 for insertion into the NCDP or forwarded by N6/N7 to the applicable OPNAV process agent for action (e.g. N1 (Manpower and personnel), N4 (Readiness, material, facilities), N00T (Training)). Those items that are doctrinal related will be passed by CFFC directly to NWDC. Events classified as having

positive enhanced warfighting capability impact will be presented to CFFC for delivery to OPNAV N6/7 and distributed as mentioned above. CFFC will carefully track the progress of these inputs. Events evaluated as not mature enough and requiring further examination will be rescheduled for additional experimentation as warranted. Events evaluated as not providing an impact will be closed out.

g. The status of all Sea Trial events will be maintained on STIMS and will be available for stakeholder review. This status will be provided to the STESG as a read ahead before meetings

8. Sea Trial Concept Development and Experimentation (CD&E) Plan. The Sea Trial CD&E Plan will be directed by CFFC and drafted by NWDC based upon the inputs of the Operational Agents. The CD&E Plan will be focused 10 years out and contain a detailed listing of Fleet priorities and mission capability gaps. This CD&E Plan will be a dynamic document, that will establish metrics to assist OAs in determining applicability of their Sea Trial efforts and allow the STESG to measure overall Sea Trial progress, support proper planning for complex testing requirements, and take full and increased advantage of emergent, smaller scale, more focused testing opportunities. The CD&E Plan should implement a comprehensive Sea Trial Roadmap that integrates studies, war games, experimentation, and exercises with proposed evaluation metrics. This CD&E Plan should include those promising concepts and technologies that speed Sea Power 21 capabilities to the Fleet.

9. Sea Trial Execution Plan. The Sea Trial Execution Plan is a two-year document and represents a collection (synchronized across NCPs) of OA planned Sea Trial events. The document will be prepared by NWDC based on inputs from the OAs and briefed to the STESG for approval each June. The Execution Plan will also contain evaluation metrics and an execution timeline. Subsequent changes in OA planning requiring a change to the Execution Plan will be briefed by the individual OA.

10. Sea Trial Information Management System (STIMS). STIMS, an NWDC developed and maintained interactive web based database, will be the central library of initiatives and technologies and will be used as the tool to manage Sea Trial events and related activity. Operational Agents, supported by all FCTs and all other Sea Trial event sponsors are responsible for populating and updating all STIMS database entries for their respective efforts. Other commands, including CNR, OPNAV, SYSCOMS, etc.,

will ensure all experimentation is fully documented in STIMS. The initiative submission format will be contained in STIMS and entry into STIMS will be the minimum essential requirement for any event to be considered for future Sea Trial status. NWDC will maintain business rules that will be used by CFFC for utilization of STIMS by all stakeholders.

11. External Sea Trial Interfaces. Sea Trial must be synchronized with other processes related to CD&E. CFFC (with NWDC as agent) shall work with OPNAV, ONR, USJFCOM and other services/agencies responsible for these processes to create a fully integrated approach to Naval transformation in support of joint/combined warfighting capabilities development.

12. Roles and Responsibilities.

a. Commander, U.S. Fleet Forces Command.

(1) Is the Lead Agent for Sea Trial and the supported Commander for all Sea Strike, Sea Basing, Sea Shield, and FORCEnet CD&E under Sea Trial.

(2) Is responsible for the composition of Sea Trial CD&E Plan (supported by NWDC), review, promulgation and periodic modification following STESG deliberations. The CD&E Plan is the principle definitive tool for establishing Sea Trial goals and will be the basis which overall Sea Trial measures progess.

(3) Will chair the STESG and act as the approval authority for STESG recommendations.

(4) Will (with NWDC as agent) assign the MUA team and associated timeline.

(5) Will endorse Sea Trial results and direct implementation via OPNAV NCDP and PPBE processes.

(6) FFC N82 is the FFC staff project office for Sea Trial. FFC N80 is the overall coordinating authority for FCTs, with FFC N82 providing assistance for CD&E efforts.

b. Commander, U.S. Pacific Fleet/Commander, U.S. Naval Forces Europe.

(1) Provide forces when available to support the Sea Trial Execution Plan.

(2) Integrate experiments into fleet exercises to the maximum extent possible while minimizing the impact on fleet readiness and training.

(3) Recommend pertinent/relevant emergent technologies and concepts as Sea Trial events. Facilitate efforts to fast track select technologies/concepts based on Sea Trial assessments.

(4) Identify to the Operational Agents focus areas for prioritizing CD&E.

(5) Provide representation to the STESG.

c. Navy Warfare Development Command (NWDC).

(1) Is the supporting commander as the Sea Trial Project Coordinator across all Navy/Naval sea trial activities. NWDC is the supported commander for development of the Sea Trial CD&E Plan and maintenance of the STIMS website. The CD&E Plan and/or the Execution Plan may be modified/updated following each STESG meeting. CFFC may direct an urgent change at any time.

(2) Will link proposed Sea Trial events to warfighting capabilities required to support Sea Power 21.

(3) Will, through representation on all FCTs, coordinate with PEOs, SYSCOMs, WCOEs, T&E Centers, labs and ONR to develop an integrated and synchronized CD&E Plan that focuses on Fleet priorities and Mission Capability gaps. The OA approved execution plans will be synchronized by NWDC and included in the Sea Trial Execution Plan. NWDC, reporting to the STESG, will coordinate these efforts across all OAs, minimizing (with a goal of eliminating) redundancies in experimentation planning, and providing an independent assessment of the combined Sea Trial process in addressing MCP gaps, and other naval and joint warfighting capability development requirements.

(4) Identify for CFFC, via the STESG, areas that are not being addressed by any proposed Sea Trial events following assessment of the overall Sea Trial effort.

(5) Focus the CD&E Plan in accordance with CFFC, Operational Agent, OPNAV N6/N7, and CG MCCDC priorities while consistently working to meet joint requirements. Ensure the plan remains agile and aggressively takes advantage of rapidly

changing testing requirements and/or opportunities to rapidly advance warfighting capability development and deployment.

(6) As part of the Sea Trial CD&E Plan development, ensure the rapid integration of lessons learned, fleet feedback, and previous experimentation analysis and assessment.

(7) Coordinate and liaison with CG MCCDC to integrate (where appropriate) USMC CD&E into Sea Trial.

(8) Supported by the Operational Agents, FCTs, and WCOEs, plan and coordinate execution, analysis and assessment of Fleet Battle Experiments (FBEs), selected limited objective experiments and other experiments as required.

(9) Promulgate and maintain an experimentation planning guidebook to provide execution guidance for field experiments.

(10) Synchronize experimentation activities and efforts to co-evolve the technology, doctrine/TTP and organizational changes required to deliver a fielded capability. Recommend to CFFC, OA(s) and all other appropriate commands opportunities to modify or cancel planned Sea Trial events to eliminate duplication of effort, hold down cost, and/or free assets to focus on higher priority Sea Trial requirements.

(11) Leverage other service, joint, and combined experimental activities to the maximum extent possible and coordinate the fleet's participation in these other experimental activities.

(12) Coordinate all Sea Trial Wargames/spiral plans with NWC and modify them as required to support Sea Trial CD&E Plan priorities.

(13) Integrate analysis and assessment results into DOTMLPF change recommendations for CFFC.

(14) As operational concepts are validated, promulgate them as doctrine/TTP.

(15) Integrate all TAC D&E activities applicable to the Sea Trial CD&E Plan.

(16) Develop and host the interactive STIMS database and provide assistance to activities entering data into STIMS as necessary. Report to CFFC and all OA(s) on the status of STIMS

usage, to ensure all Sea Trial events are fully documented in the database.

(17) Coordinate with ONR, MCCDC/VCNR and SYSCOMs to ensure R&D activities support near, mid and long term Sea Trial priorities. Obtain visibility over ONR Future Naval Capabilities (FNC) and Naval Systems Innovations (NSI) to assist in determining which elements are mature enough for inclusion in Sea Trial events.

(18) Apprise CFFC, supported by the Operational Agents and all other appropriate commands, of guiding requirements and modifications/limitations to approved STESG plans as available funding and/or cost estimates to support events evolves.

(19) Maintain a repository of Sea Trial results.

d. Commander, Second Fleet (COMSECONDFLT) Commander, Third Fleet (COMTHIRDFLT) and Commander, Naval Network Warfare Command (COMNAVNETWARCOM).

(1) Serve as the supported Commander and Operational Agent for Sea Trial activities associated with the pillars under their cognizance and as a force provider for Sea Trial activities.

(2) Coordinate fleet activities in their respective AORs to support the Sea Trial Execution Plan.

(3) Coordinate with Marine forces and other numbered fleet commanders as appropriate.

(4) Develop Fleet priorities for CD&E and nominate high impact capabilities, activities and technologies to be incorporated into CD&E plans.

(5) Review and approve recommended execution plans developed by FCTs in support of assigned pillars. Forward and brief issues to the STESG for resolution as required. All designated FCTs will fully support OAs in these efforts.

(6) Support joint and combined CD&E for all pillar related activities, as directed, including allied and coalition requirements.

(7) Provide Military Utility Assessments of Sea Trial experimentation to CFFC for approval and forwarding as appropriate.

(8) COMTHIRDFLT coordinate Sea Based Battle Lab (SBBL) activities as required to support the Sea Trial CD&E Plan.

e. Naval War College (NWC).

(1) Coordinate with NWDC to fully integrate and synchronize all Sea Trial Wargames/spiral events with the Sea Trial CD&E Plan.

(2) Coordinate, with NWDC, a long-term wargaming plan for integration into the Sea Trial CD&E Plan.

(3) Coordinate with CG MCCDC for integration of USMC CD&E into Sea Trial (DIRLAUTH with Expeditionary Force Development Center (EFDC) for USMC concept development and JCD&E. DIRLAUTH with Marine Corps Warfighting Lab (MCWL) for experimentation).

(4) Coordinate with other services and JFCOM to ensure Sea Trial initiatives are reflected in appropriate ongoing joint experimentation, and that other service initiatives are reflected in applicable naval wargaming.

f. Chief of Naval Research (CNR).

(1) Serve as the supporting commander for Sea Trial S&T activities.

(2) In cooperation with NWDC and MCCDC, nominate FNC and NSI activities that are sufficiently mature for inclusion in Sea Trial.

(3) Provide representation to the STESG.

(4) Provide representation to the FCTs as assigned.

g. OPNAV N6/N7.

(1) Serve as supported Warfare Sponsor for Sea Shield, Sea Strike, Sea Basing, and FORCEnet in the development of

Mission Capability Packages (MCP)/Naval Capabilities Plans and follow-on development of a Sponsor Program Proposal (SPP).

(2) As co-chair of the Technology Oversight Group (TOG), and working with ONR, N6/N7 will ensure FNC projects support the Sea Trial CD&E Plan objectives where applicable.

(3) Serve as supporting Resource Sponsor for Sea Shield, Sea Basing, Sea Strike and FORCEnet.

(4) Assign Platform Sponsors as contributing Sea Trial resource sources for addressing capability gaps identified by both the NCDP and as determined by Operational Agents (Working together with OPNAV Warfare Sponsors in a collaborative role).

(5) Incorporate Sea Trial results as endorsed by CFFC into the NCDP or forward to the applicable OPNAV process agent for action (e.g. N1 (Manpower and Personnel), N4 (Readiness, Material, Facilities), N00T (Training)). Those items that are doctrine-related will be passed by CFFC directly to NWDC.

(6) Provide representation to the STESG.

(7) Support the FCTs through the consulting membership of the various MCP leads to provide a conduit of information from the MCPs and NCPs.

h. Warfare Centers of Excellence (WCOE).

(1) Integrate tactical development and evaluation into the Sea Trial CD&E Plan to include TTP development for experiments, TACMEMO development for use of operational prototype systems, and schedule events through NWDC in conjunction with complementary Sea Trial field experiments.

(2) Support CD&E through representation on FCTs assigned to support core competency areas.

i. Systems Commands.

(1) Ensure appropriate R&D, experimental and spiral development activities are included in the Sea Trial CD&E Plan and resource participation in Sea Trial activities as required.

(2) Support Sea Trial activity in coordination with NWDC.

(3) Provide representation to FCTs as assigned.

(4) Provide input to CFFC, in conjunction with OPNAV, on the capability of the industrial base to evaluate the concepts under development as part of the Sea Trial efforts with particular focus in meeting MCP identified gaps.

(5) Provide representation to the STESG.

j. CG MCCDC (DC, CD).

(1) Serve as a supporting commander as the USMC Sea Trial Coordinator and the supported commander for USMC/Navy Sea Trial CD&E activities.

(2) Coordinate USMC CD&E activities, including participation in FORCEnet, as required to support the Sea Trial CD&E Plan.

(3) Coordinate USMC Training & Education Command (TECOM), EFDC and MCWL activities to include wargaming as required to support Sea Trial CD&E Plan.

(4) Coordinate USMC S&T efforts and Marine Corps Systems Command (MCSC), HQMC and Marine Corps Advocate, and Joint CD&E activities in support of Sea Trial CD&E Plan.

(5) Coordinate assignment of USMC Operational Forces, as fleet counterparts, to participate as Sea Trial Operational Agents, and assign USMC representatives to the FCTs.

(6) Provide representation to the STESG.

(7) Provide input to STESG recommendations.

k. TYCOMS Provide representation to FCTs as assigned.

l. Naval Postgraduate School.

(1) Support Sea Trial through conceptual development and specific research in the areas of Sea Shield, Sea Strike, Sea Basing and FORCEnet in accordance with CFFC/NPS Memorandum of Agreement.

(2) In conjunction with NWDC, support analysis of Sea Trial Event products. Additionally, develop and support long term Red Team Cells committed to representing potential major

conflict, terrorism and other threats. Red Cells will be tasked to support war games and other experiments in order to raise the level of Red Team play, and to represent the potential capabilities joint forces may have to overcome in the future.

m. COMOPTEVFOR. is a supporting commander for planning, evaluation and operational impact assessment of Sea Trial initiatives.

A. H. KONETZNI, JR.
Deputy and Chief of Staff

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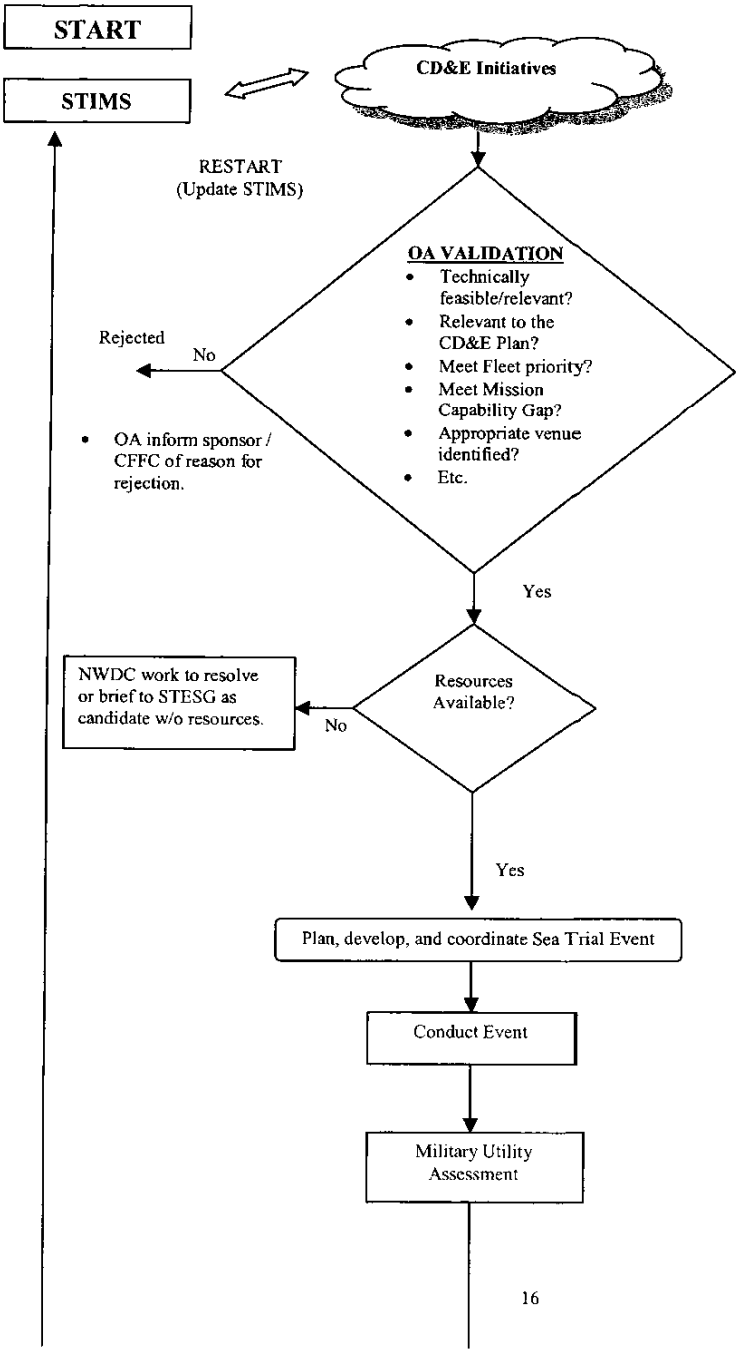

- START/ENTER Process via STIMS database. Events submitted by FCTs, OPNAV, ONR, Industry, SYSCOMS, other agencies.
- NWDC distribute to all stakeholders.

- OA conducts validation assisted by NWDC and FCT.

- Sponsor develops Experiment Plan and Data Collection & Analysis Plan
- NWDC aligns events across all pillars and presents consolidated Execution Plan to STESG
- CFFC designates Military Utility Assessment (MUA) Team and timeline
  - Proposed by OA

- OA publish Quick look
- Event sponsor complete analysis
- MUA team completes MUA and submits to OA for approval.

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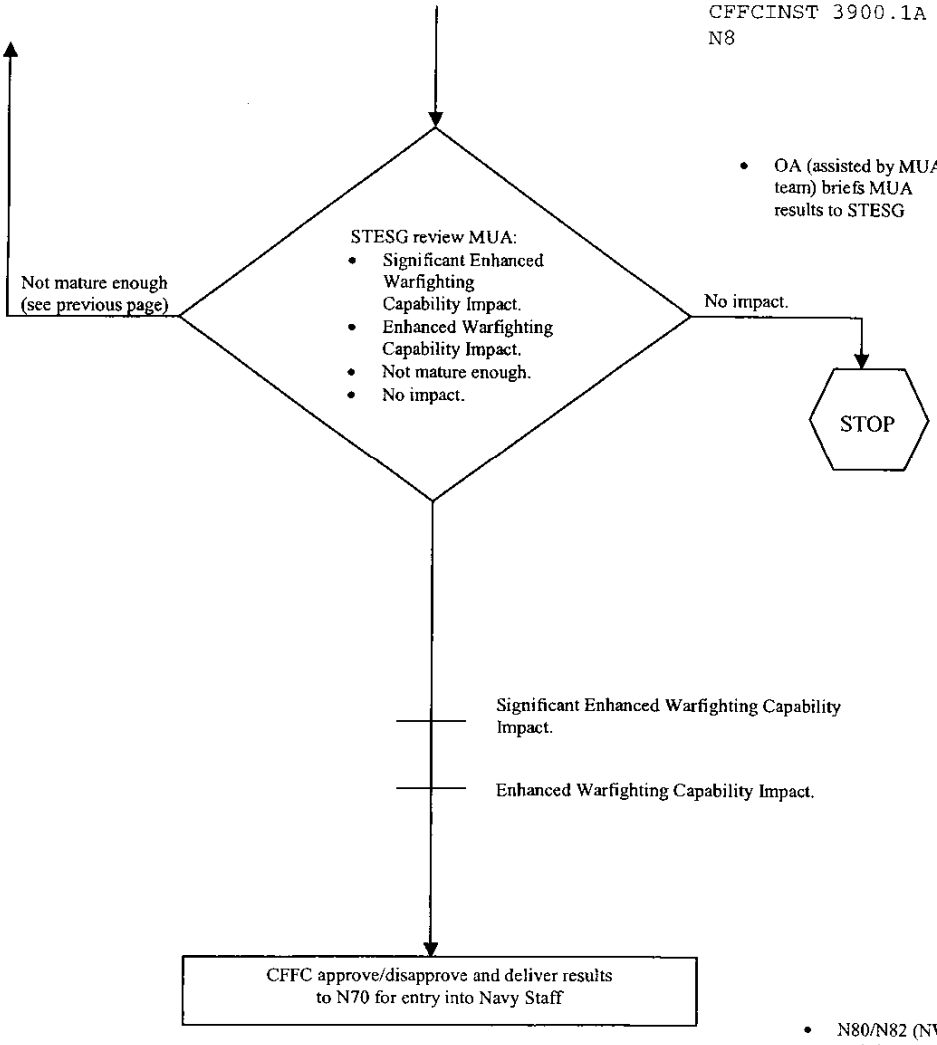
• OA (assisted by MUA team) briefs MUA results to STESG
STESG review MUA:
• Significant Enhanced Warfighting Capability Impact.
• Enhanced Warfighting Capability Impact.
• Not mature enough.
• No impact.
Not mature enough (see previous page)
No impact.
STOP
Significant Enhanced Warfighting Capability Impact.
Enhanced Warfighting Capability Impact.
CFFC approve/disapprove and deliver results to N70 for entry into Navy Staff
• N80/N82 (NWDC assist)
• NWDC track & update data base

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